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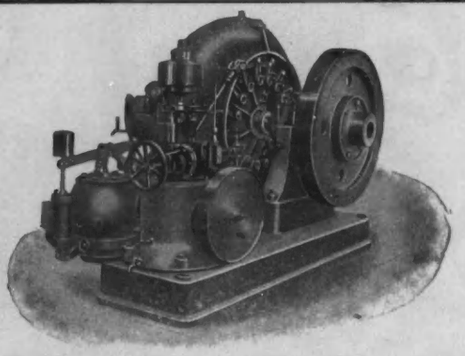

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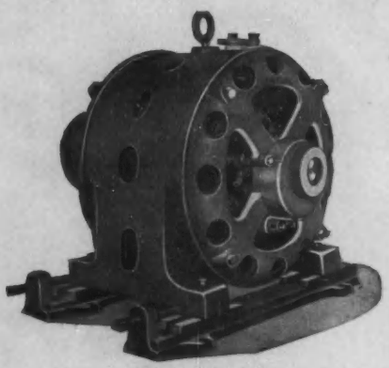

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THE STORY OF THE FOLSOM POWER PLANT

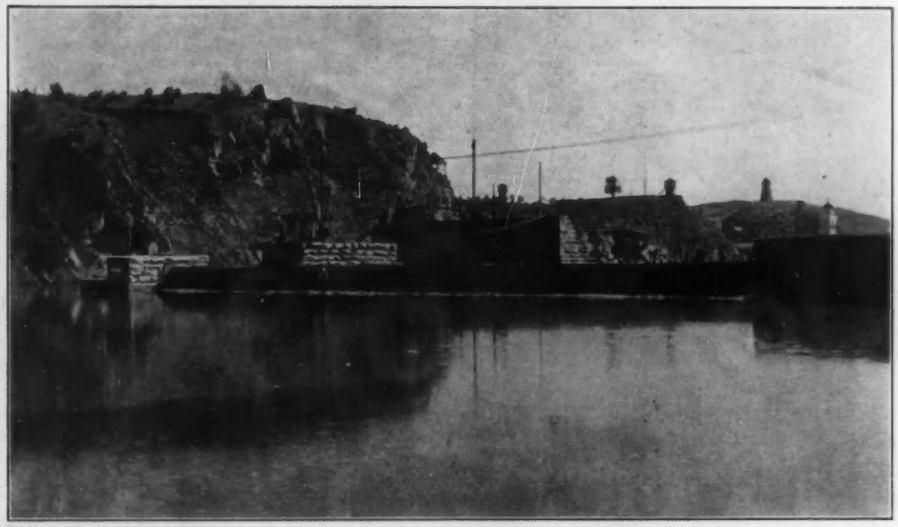
BY ARCHIE RICE.

Archie Rice

At the little town of Folsom, California, on the American river to the eastward of Sacramento, is the oldest of the eleven hydro-electric power plants now owned by the Pacific Gas and Electric Company. While not the first installation in America for long-distance transmission of electric energy, Folsom was among the pioneers. It was preceded only by the sixteen-mile power system installed in the latter part of 1892 for a mine at Bodie, California, and by a very few similar plants established after Bodie and before Folsom began, in July of 1895, sending electric energy through a twenty-two-mile power line to the city of Sacramento. There the current was to furnish light, operate machinery, and propel street cars.

Circumstances often change the purpose of a man's life. An isolated farmer may be disturbed by the advent of a railroad and the creation of a townsite on his property. A few years later these circumstances may have changed the quiet rustic into a bank president, a hotel proprietor with a diamond stud, a man of affairs in his own community.

Unexpected developments in local and business conditions helped to bring about the establishment of that power plant at Folsom. It was a creature of circumstances, plus. And the plus was the personal energy of a few men — Horatio Livermore, Charles Livermore, and Albert Gallatin, Sr.



Upstream Face of Folsom Dam, Showing Prison Watch Towers on Hill.

Back of the beginning of Folsom's advent as a producer of electricity there was a series of developing events covering a period of forty years and involving an old Spanish ranch, placer mining, a logging industry, state politics over the selection of a prison site, transfers of property ownership, six years of convict labor on the Folsom dam and power canal, disputes with state officials as to water privileges, and years of litigation, which was perpetuated in a case taken before the Supreme Court of California to determine

the relative rights of the power company and the state prison in the use of the water flow, and that case was not satisfactorily settled until the 29th of September, 1909.

In pioneer mining days the American river was a mint, where a great army of argonauts worked with shovel and rocker. Up the granite-ribbed bed of that stream, miles above Folsom, the middle and south forks of the river come together from two sides of the famous Georgetown Divide in El Dorado county. There James Marshall, in February of 1848, made the first discovery of gold in California. He happened upon it while repairing a water ditch at Sutter's mill. That Georgetown Divide district is mountainous. Half a century ago it was heavily timbered with sugar pine and yellow pine of exceptionally good quality.

Things were booming in the mines, and Sacramento was the commercial center of the mining industry. Lumber became a necessity, and its production a profitable enterprise. By 1855 the Sacramento Valley Railroad, from Sacramento to Folsom, was completed. It was the earliest steam road on the western slope of the continent. "Uncle George" Bromley, the well-known, jovial, nonagenarian member of the Bohemian Club, was its first passenger conductor. The day the first train ran was the most notable in Folsom's history. Men whose names loom big in the annals of California were there to celebrate the event. Five or six years later Stanford and Huntington and Crocker and Hopkins started the idea of a transcontinental railroad, and Stanford, as war-time Governor, lawyer, and personal friend of Lincoln, got the government land concessions that made possible the financing of the amazing undertaking. That little railroad to Folsom became in 1863 the initial part of the Central Pacific's transcontinental line.

These facts are not necessary to the story of the Folsom power plant, but they have a historical connection with it, because the very bricks of which the power house is made were part of the first railroad shops built at Folsom in 1855, upon the spot where the Folsom passenger station now stands. And just upstream from the power house is one of the original granite masonry abutments upon which rested the first bridge built for America's first transcontinental railroad.

In 1851 the Natoma Water and Mining Company had acquired some rights along the American river, and in 1857 it purchased from Charles W. Nystrom lands on the east bank, and also bought river-channel lands.

Horatio P. Livermore and his brother, Charles E. Livermore, were interested in the lumber business. They wanted to market a lot of that timber from the Georgetown Divide, and they had to have river rights that would permit them to float the logs down stream. So they had bought river land and acquired the "Rancho Rio de los Americanos," which suggests that the original Spanish name of that stream was "River of the Americans," probably called from the Americans like Sutter and others who settled along its course before gold was discovered.

In 1858 the California Legislature decided to establish a branch prison to supplement the original penitentiary at San Quentin, and a choice of location was restricted to the granite-quarrying district at Rocklin or the granite district near Folsom. Year after year no selection of a site was made by the prison directors, and the matter was allowed to drag.

The Livermores needed a still-water basin somewhere near Folsom to catch the logs as they came down stream. So, in 1866, Horatio Livermore, as president of the Natoma Water and Mining Company, laid the foundations of the present Folsom dam, about two miles up the stream from the narrow little town that now claims 1,500 people but does not look the part.

In 1868 the Legislature awakened from its Rip Van Winkle sleep of ten years and pushed through a resolution requiring that a choice between Rocklin and Folsom be made by the prison directors before July of that year. The Livermores' dam was only partly built, and there was an immense amount of work ahead to complete it and the outflow canal that was to float the logs down to a proposed sawmill near the present site of the power plant. The Livermores met the prison directors and offered big inducements to get the prison at Folsom. Their proposition was accepted.

The Livermores were to give the State 350 acres of quarrying and agricultural land on the east side of the river adjacent to the dam. They were to include with the land a perpetual and exclusive right on the part of the prison to waterpower produced by a fall of five feet. This was to be provided at the end of the first 1,000 feet of canal just before it left State property and resumed its course down to Folsom. In exchange for the land and the waterpower the Livermores, as soon as the prison should be finished, were to get $15,000's worth of convict labor to complete their dam and part of their canal.

In May of 1872 the Livermores filed a claim to a flow of 100,000 miner's inches of water.

The State decided, in 1874, that it would be desirable for the new prison to have some other lands adjoining the original tract, and an additional 134 acres was secured from the Livermores, making a total area of approximately 484 acres.

The prison was not completed till July of 1880. No convict labor could be available until the prison was built.

The water company had gone on working and had expended an aggregate of $119,000 in constructing its two-mile railroad from Folsom up to the dam and in laying the foundation of the dam itself. But it had not yet received one dollar in money or an hour of labor from the State in payment for that tract of 484 acres upon which the new prison was standing. For twelve years the company had been waiting for that promised pay in convict labor.

In September of 1881 the Natoma Water and Mining Company became the Folsom Water Power Company, a change of name but not of men chiefly interested. The company then demanded the prison labor due. But in August of 1882 a controversy arose. The company insisted that it was not giving all that land and those waterpower rights for the originally designated $15,000's worth of prison labor. No; there was $30,000's worth of convict labor coming to it. The warden of the prison continued to offer eighty convicts

who would be put to work on the job, and the company just as regularly declined to accept the labor with its implied payment of only $15,000.

The company had stopped work on the dam. The State brought suit to compel the company to accept the convict labor and go on with the construction of the dam and the canal. But the Superior Court decided that the company did not have to accept the labor unless it so desired. Thus matters dragged along until 1888, when Governor Stoneman came into office. Then the Folsom Water Power Company made a new proposition to the State the 5th of May, 1888. The proposition was this: the State should furnish the convict labor necessary to complete the dam and build the canal as far as the mud sink at Robber's Ravine, a distance of about 6,000 feet below the dam, and in consideration of that labor the company would then give the State additional waterpower produced by a fall in the prison yard of 7.33 feet, instead of the originally designated 5-foot fall; would give the State the right to use the company's railroad line from Folsom up to the prison, provided the State kept the road in repair; would permit the taking or pumping from the canal of all water desired on the prison property for irrigation and domestic purposes; would permit the taking of gravel from the adjacent river bed, which was all owned by the company; would permit ingress and egress over the company's lands on the river side of the prison, and the passage over the company's land of a prison sewer to flow into the river. These rights, aside from the water power, were considered by the prison warden to be worth more than the value of the convict labor desired. He reported to the Governor that the water power alone would produce 800 horsepower, which, at the existing price of fuel, would otherwise cost $64,000 a year to produce and would mean to the State the equivalent of a million-dollar power investment.

The company's new proposition was readily accepted by the State, and the first day of July, 1888, convicts were put to work on the dam and the canal.

H. T. Knight was the company's engineer of construction. Later he started the power plant as its superintendent, a position in which he was succeeded by his son. He had all along been supervising the work on the dam. He continued doing so. The understanding was that the company should supply the granite, the materials, and the engineering plans, and that the State should simply furnish the manual labor. For exactly six years the convicts worked on the dam and the canal. During that time they did an aggregate of 520,349 days' labor, which, valued at 50 cents a day, was equivalent to the payment of $260,174 to the company. In addition to this convict labor, the State provided free labor for which it paid $24,508. This made the total price paid by the State equivalent to $284,682, but the labor was worth to the company many times 50 cents a day.

Albert Gallatin, Sr.

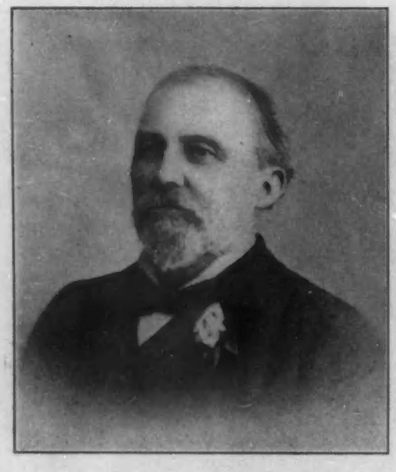
Folsom Prison Power House, showing the Pacific Gas & Electric Co.'s Dam upstream and from it the canal along the near bank of the river.

The water was first turned into the Folsom canal and allowed to flow through the prison yard in January of 1893. The prison had built a power house of its own to use the seven-foot fall. The water company had meanwhile completed at its own expense the remainder of the canal.

The original intention had been to have the canal bring logs down to a sawmill at Folsom, and thence to convey the water on for irrigating purposes. This idea had evolved into a plan for having an electric power plant at Folsom that would supply energy to manufacturing enterprises which it was hoped would be established there. But before the dam and the canal were completed long-distance transmission of electric energy became a practical fact. So all those dreams about factories at Folsom went glimmering, and plans were changed to give Folsom a hydroelectric plant, its prime object then being the transmission of energy down to Sacramento. Late in 1892 Horatio Livermore and Albert Gallatin secured a street-car franchise in Sacramento, and November 1st of that year they conveyed the franchise to the Sacramento Electric Power

and Light Company, which later took current from Folsom.

The Livermore brothers were natives of Boston and came to California in the later 50's. Horatio Livermore was the financial manager of their enterprises, and was married. Charles never married, but always made his home with his brother. He embarked in the wholesale drug business in Nevada in the palmy days of the Comstock, and later engaged in quicksilver mining with Horatio. But their chief concern was the development of water power at Folsom. Charles Livermore was at the head of the company when the Folsom plant began operations. He was an ardent lover of athletic sports, established the first rowing club on California waters, and was one of the fourteen original incorporators of the Olympic Club of San Francisco. While not educated for engineering or art, he developed natural talents for these subjects, and was an original member of the San Francisco Art Association. The names of Horatio Livermore and Albert Gallatin are intimately associated with the Folsom enterprise and with the business life of Sacramento more than a generation ago.



Charles E. Livermore, who was president of the Company when the Folsom Plant was started.

Up-stream end of the old Folsom Sawmill.

When the Folsom dam was constructed, water-power under high head was not yet a practical engineering development. By using a very gradual fall of about one foot in every 1000 feet of canal the promoters found they could deliver an enormous flow of water to Folsom at a point about eighty feet above the river bed. From the forebay at the lower end of the canal they could easily secure a sudden fall of fifty-five feet, and that would give them what was then considered considerable power.

They figured that the American river could always be relied upon for an unusually large flow during the dry season. Its numerous branches all have their rise in the Sierra Nevada mountains within a few miles of Lake Tahoe. The heavy snowfall on the ridges there and the late melting of this snow would furnish abundant water late in the season when the effect of the rains had long since waned in other districts. The theory was all right, but the practice did not work out just that way.

The Folsom plant started July 13th, 1895. But its real public inaugural was the day it sent power through to Sacramento for the Native Son's electrical carnival, the 8th of September, celebrating the forty-fifth anniversary of the admission of California into the sisterhood of States.

During the summer of the following year the waterflow in the American river became surprisingly low. Larger demands had come upon the Folsom plant for electricity in Sacramento. What is now the Sacramento Electric Gas and Railway Company had in December of 1895 secured the street-lighting contract by underbidding the old Capital Gas Company for a general reduction of twenty-five per cent, and much other electric business was obtained. Accordingly it became necessary to install a supplementary plant at Folsom, and it was established early in 1897, to develop an additional 750 kilowatts by using the twenty-six-foot fall after the water left the power house on its way back to the river.

In 1896, also, a sawmill was established adjacent to the canal and about a quarter of a mile above the Folsom power house. Logs were floated down the river and then through the canal. Here again trouble arose with the prison authorities. Up to that time the headgates of the canal had been operated from the prison power house. Now the prison refused to raise the gates a little higher to permit the passage of logs. Then arose the questions, Whose dam is that, any way, and who has the right to open the headgates?

In the summer of 1897 the American river got still lower. There was not sufficient waterflow to produce the desired power. It became necessary at Sacramento, from September 22d to October 3d, to shut off current from such large consumers as the Phoenix Mill, the Buffalo Brewery, and the Southern Pacific Railroad shops.

In 1898 the American river dropped still further, and so suddenly that an auxiliary steam plant that was being built at the sub-station in Sacramento for just such an emergency had to be rushed to completion. Even then it was not quite quick enough, because July 17th, the night before it started, the water fell below the top of the penstocks, and the Folsom plant had to be shut down for that evening.

In 1899 a contract was made with the Bay Counties Power Company to secure auxiliary energy the next year from that company's plant, then being built at Colgate on the Yuba river. Meanwhile the series arc lighting system of Sacramento was switched on to the Capital Gas Company's plant, and the steam engine at the sub-station was left to provide the energy for the street railway and such alternating current as its capacity could furnish. With the perfection of the transmission system from the Colgate plant the problem of water storage for Folsom became less alarming, and in June of 1902 John Martin and Eugene de Sabla Jr., the men behind the Colgate enterprise, secured a controlling interest in the Sacramento company and the Folsom plant, though the active management did not change till May of 1904. The control of both the Folsom plant and the Sacramento company became, late in 1902, a part of the system of the California Gas and Electric Corporation, and in January of 1906 it was conveyed to the Pacific Gas and Electric Company.

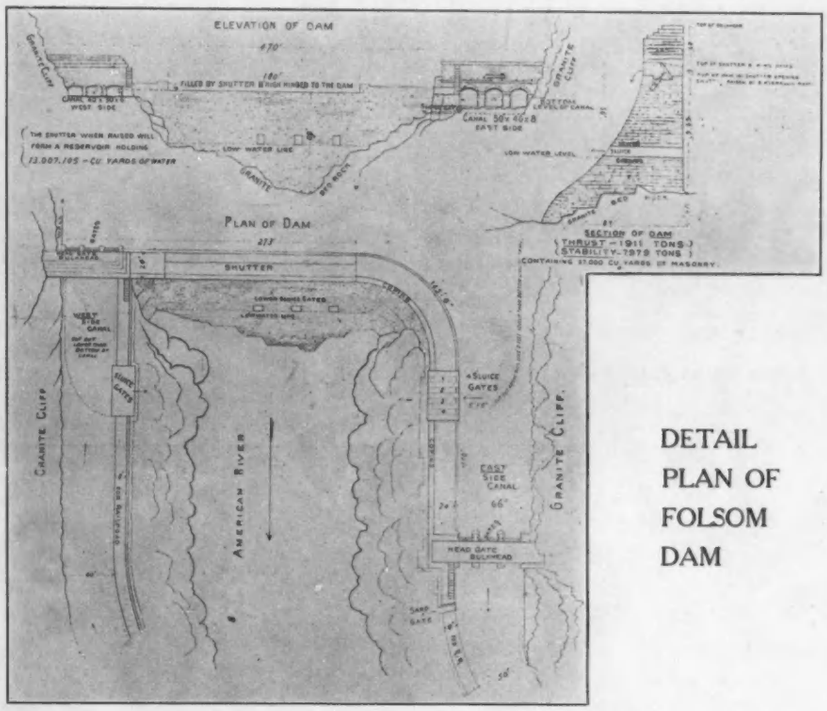
While the Folsom plant receives an enormous flow of water through its canal, the impounding area provided by the dam is not sufficient to maintain that great flow all through the dry season. The fall at the power house is comparatively low, and a tremendous volume of water is required to produce the power.

Carefully made surveys of the catchment area of the American river have indicated that it would be possible to construct in the mountains impounding reservoirs that would permanently increase the flow at Folsom until that flow during the season of least water would be as great as the maximum canal flow now known at the Folsom plant. And the construction of such a system of storage reservoirs would perhaps make constantly available at Folsom 5000 horsepower, where now it is prpoducing from 800 to 1000 horsepower during the lowest flow of the American river.

Where the Folsom dam is located the American River narrows naturally between blackened granite bluffs that taper off down-stream into a river bed that for nearly two miles suggests a confusion of solidly made stone walls between which flows the surplus water from the dam.

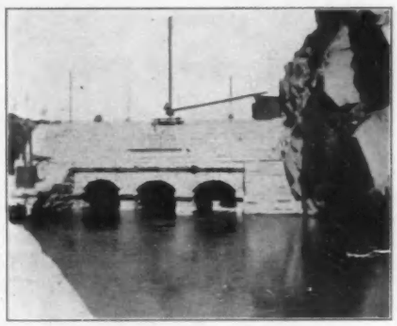
The dam itself is 81 feet high, 854 feet long, and 16 feet thick at the base.

The elevation of the dam is 210 feet above sea level and 175 feet above the level of the city of Sacramento. It is of solid granite masonry, as may be seen by the accompanying illustrations and the detail drawing. The first intention was to have a canal on each side of the river, but only the east side canal was built. This canal consists of three sections. The first is 2000 feet long, and is cut into solid granite cliffs and walled up on its river side with the granite cut from the cliffs. At the end of this section is the prison power house, a granite structure through which all the water of the canal flows, when it is not purposely diverted to avoid the power house and continue right along down to Folsom. The second section is 4000 feet long, and has its inner side faced with a masonry wall and the outer side protected against the river by heavy riprap work. The first two sections were built by convicts. The third section is 3500 feet long, and was built by the company. It cuts through earth and rock formation, and has an earth and rock fill on the outer edge, which is also



DETAIL PLAN OF FOLSOM DAM

Folsom Dam Across American River, with Outflow to Canal in Foreground.



Downstream Face of Canal Headgates, Showing Massive Granite Bluff at Right.

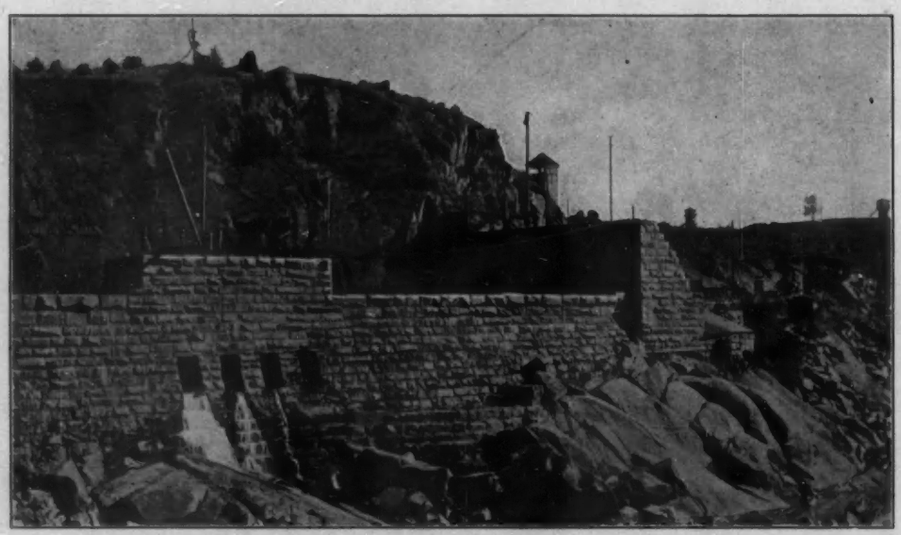
protected in places by riprapping. The total length of the canal is 9500 feet, or almost exactly 1.8 mile. A standard gauge railroad track runs along the canal bank next to the river.

The canal is generally forty feet wide on the bottom, its banks sloping up to give it a width of fifty feet at the top, and the depth is eight feet. At full flow the canal is capable of carrying a constant run of 70,000 miner's inches, or 1750 second-feet, and the plant takes 40,000 miner's inches, or 1000 second-feet at full load.

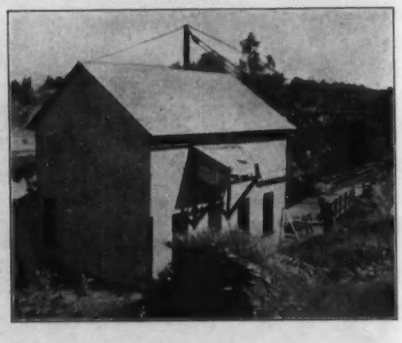
could just keep his nose above water and float down to safety without being discovered.

The canal ends in a large granite forebay that is made double by having a granite partition wall dividing it into two sections. This permits one to be cleaned of accumulated silt while the plant is still taking water from the other.

The forebay is 150 feet long, 100 feet wide, and 12 feet deep, and the fall to the turbines is fifty-five feet through four penstocks eight feet in diameter and made of five-eighths-inch steel. Each pair of turbine



View of Wing Dam and Its Four Sandgates, with Headgates to the Right.



Secondary Plant at Folsom Power Station. Run by Outflow from First.

Looking Up Canal Toward Headgates—Folsom Prison Quarry on Right.

Further Down the Canal, Looking Back Toward Prison Rock Crusher and Watch Towers.

Folsom Power House, with Outflow Canal Through Solid Granite.

Three enormous headgates, each sixteen by fourteen feet in the clear, are situated at the entrance to the canal at the end of the wing dam, and these huge headgates are operated by hydraulic rams, a system which is possible here where there is never snow or ice to interfere. The wing dam is provided, as seen in the illustration, with four sandgates or sluices to carry off sand and prevent its being taken down canal to interfere with the waterwheels in the prison plant. And supplementing these sandgates there is a ledge across the canal itself to catch the sand that may come through the headgates. Below the prison power house are four other sandgates.

Twice convicts have unsuccessfully tried to escape by dropping into the canal, on the theory that a man

wheels is ten feet in diameter. At the time of its installation the hydraulic equipment at the Folsom plant, weighing upward of 400,000 pounds, was considered the most massive and powerful in the world, excepting only the plant at Niagara Falls.

The equipment of the original plant consisted of four S. Morgan Smith turbines, four Lombard governors, and four 3-phase, revolving-armature type, 800-volt, 750-kilowatt generators of General Electric make. There are four transformers, one held in reserve, and their combined capacity is 5000 kilowatts, or 6600 horsepower. The only change from the initial installation is in the transformers, which have been altered to deliver 60,000 volts instead of the original voltage of 10,000.

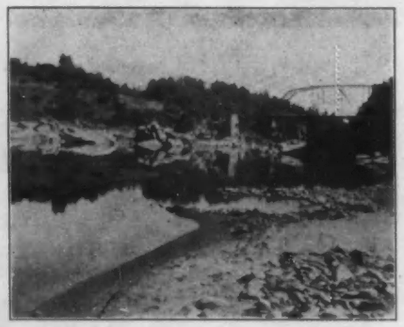
The supplementary, or lower, station at Folsom takes advantage of a twenty-six-foot fall of the water after it leaves the old power house, and there an additional 750-kilowatt unit is installed. It is of the 3-phase, revolving-field type, 11,500-volt, General Electric pattern.

The turbines at the upper power house, under a fif y-five-foot head, run at the rate of 300 revolutions a minute, and are directly connected to the armature shafts of the generators by insulated flexible couplings. Each pair of wheels is supplied with a steel flywheel ten feet in diameter, weighing 10,000 pounds, and having a speed at the outer edge of 9425 feet a minute. Heavy steel rims are shrunk on the wheels to provide for the great strain such speed produces.

The transformers are on the second story of the building. The high-tension leads are led from the transformers to the double pole lines out through a hood-protected opening in the end of the station. The pole line consists of forty-foot, round, cedar poles extending to Sacramento in two parallel lines, one on each side of the county road. From the power house to the railroad station at Folsom the distance is 1056 feet, from the Folsom railroad station to the city limits of Sacramento is 19.4 miles, and from the edge of the city in to the Sacramento sub-station is 1.9 mile, making a total transmission distance of practically twenty-one and a half miles.

A change was made in the transmission line early in 1905, when the pole line on the south side of the county road was supplied with larger insulators, its wires were given a greater spread, and the potential carried was raised from 10,000 to 60,000 volts.

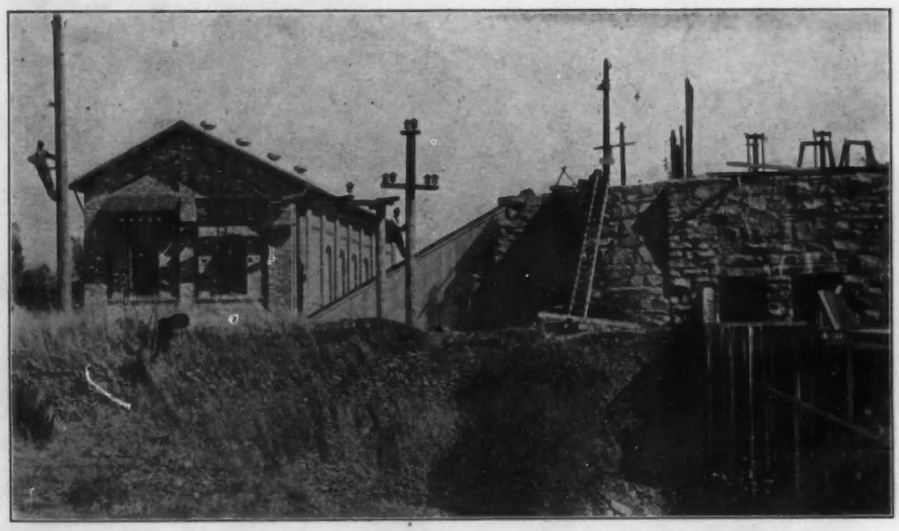
In the preparation of this sketch the writer acknowledges information obtained from an article published in 1895 by the late George P. Low in the "Journal of Electricity," from C. W. Hutton, an old employe of the Pacific Gas and Electric Company, but now with the Sierra & San Francisco Power Co.; from the report made to the State Board of Prison Directors in 1900 by Warden Aull at the Folsom penitentiary; from some data kindly supplied by United States District Attorney Devlin, who was formerly a prison director and a Sacramento lawyer; and from various employes of the Pacific Gas and Electric Company who have personal knowledge of some of the events as they occurred.



County Bridge Across American River, also Old Stone Abutment that supported first Transcontinental Railroad Bridge.

Jacob C. Kearns, who has been at the Folsom Plant ever since the Machinery was Installed.

R. A. Rose, Foreman Frank O. Hutton, and George Ferguson, who has been at the Plant from the start.



Folsom Power House and Granite Forebay.

The Four Penstocks, through which the Water Plunges from the Forebay to the Power Wheels of the Folsom Power.

THE WATT-HOUR METER.

BY WM. M. SHEPARD AND ALLEN G. JONES.

CHAPTER I.

GENERAL.

Definition.

The name "recording wattmeter" or "integrating wattmeter," is often erroneously applied. The true name for the instrument commonly used for recording the energy flowing in an electrical circuit for a certain period of time is the watt-hour meter, since it records the product of the watts and the time. The "recording wattmeter" in the true sense of the word is the instrument which is ordinarily known as the graphic, or "curve-drawing wattmeter," which records the watts for any given instant without taking into consideration the time element.

Relation of the Meter to the Central Station.

The relation of the meter and the meter system to the distributing station is a factor of great importance, the gravity of which, as a rule, is not fully realized; especially is this true with the small and the medium-sized lighting and power companies. The revenue of the distributing company depends on the meter in more ways than are at first apparent,and the continued accuracy of its meters is a matter materially affecting its financial success. Inaccurate meters are eventually detrimental to the interests of the company selling current, regardless of whether the meter runs fast or slow. A fast meter furnishes the consumer a very just cause for complaint, and when detected usually reacts strongly against the company in producing mistrust of its methods and a general feeling among its customers that they are paying for something that they never receive. Such a feeling is to be avoided by every possible means, as it causes endless complaints and in many cases the loss of customers with the resulting loss in revenue.

Slow meters, of course, act directly on the company's revenue, failing to record the power which is actually being delivered. This is often a very serious source of loss, especially where meters are operating at light load for a considerable portion of the time, as is almost always the case under commercial conditions. It is this inaccuracy in meters at light loads that constitutes, in the majority of cases, the chief source of loss to the distributing company, and especially is this true where there is no attempt made to periodically test the meters and make any minor adjustments that may be necessary. Meters are often installed under conditions that are by no means the most favorable for a delicate piece of apparatus; this however, is frequently unavoidable, as the meter must be installed wherever power is sold. It is often installed in places which are inaccessable, allowed to become covered with dust and dirt, and in some cases it is placed where it is subjected to severe and continual vibrations; it is usually then left to take care of itself, receiving no further attention than to be read once a month. Under such conditions it is almost inevitable that the meter will eventually run slow, especially on light loads.

In carefully managed and well designed direct current systems, the energy lost in line drop and otherwise unaccounted for between the station bus-bars and the consumer's meters may be as low as 15 per cent, but on alternating current systems, having many small transformers connected to the lines which are continually consuming power in the form of core loss, and with meters which are poorly maintained or entirely neglected, the loss shown by the comparison of the reading of the station meters and the consumer's meters may be as high as 70%. From 15% to 20% represents very good practice on direct current systems, and from 20% to %30 on alternating current systems.

The Selection of Meters.

The selection of meters is a question which should be thoroughly investigated. While there are several excellent makes of watt-hour meters on the American market, there are still others which may be disastrous to the revenue of the distributing company. It is not always the meter which when new shows itself capable of finer adjustments and consequent high initial accuracy that will prove the most satisfactory or the most accurate after a period of service under average commercial conditions. Of course initial accuracy is an important factor, but it should not be sought at the expense of continued accuracy. The meter should be of as substantial and rugged construction as is consistent with efficient design. Such a meter will prove to be more satisfactory and will show less error after a period of service than will a meter of more delicate construction, although when new it can be adjusted to a finer degree. This question of continued accuracy is of paramount importance and should always be borne in mind while selecting the instrument upon which the revenue of the company is to depend.

Factors Affecting a Meter's Accuracy.

The factors affecting the accuracy of a watt-hour meter are various, but the two principle ones are friction and the weakening of the permanent magnets. If these two factors could be eliminated, a meter once accurately adjusted would remain so indefinitely. Unfortunately, however, these two factors do play a very serious part in the performance of the meter, the most serious being friction. If the friction component was a constant quantity it could be compensated for by the light load adjustment device and thus permanently eliminated as regards the meter's accuracy. It has been found though that friction is an extremely variable quantity and in the case of any motor-meter it may vary by quite a large amount, even under very favorable conditions. For this reason a high value of the torque, or turning effort is very desirable, since with a high torque the percentage of this torque required to overcome any increase in friction is relatively small, and the percentage increase of effective torque due to any decrease in friction is also correspondingly small. Thus it will be seen that a meter having a high torque will not suffer in accuracy nearly so much for the same amount of change in friction as will a meter of low torque. There is, however, a value for the torque, which if exceeded, will result in poor economy, because by increasing the losses a higher value of torque can be produced. It can therefore be readily seen that the design of a meter should be

such that this ratio of torque to watts loss will be at the most economical point.

Since friction is the most serious factor affecting the accuracy of a watt-hour meter, it is essential that every care and precaution be taken both in the design and the manufacture to insure low initial friction, and to insure as far as possible against changes in friction after the meter has been in service for some length of time. Friction will develop in the lower jewel bearing, in the upper bearing and in the recording mechanism.

The Jewel Bearing.

In order to obtain low friction in the jewel bearing the revolving element should be light in weight; only the highest grade of jewels should be used, and they should be carefully selected and ground. The pivots, or the bearing points, should be of the finest grain of glass-hardened steel. It is usual practice of manufacturers to mount the jewel on a spring support, thus taking up any sudden vibrations and thereby preventing excessive pressure between the jewel and the bearing point, therefore prolonging the life of each. Although the actual weight supported by the lower bearing is small, the pressure between the jewel and the pivot in a meter is great, since the actual contact area is exceedingly small, being as it is, almost a "point" contact, so that the pressure per square inch of contact reaches an extremely high value. It is for this reason that jewels of the best quality and "glass-hardened" steel pivots are necessary in the construction of the lower bearing, as any other material would quickly break down and develop excessive friction. The otherwise objectionable "point" contact between the jewel and the pivot is necessary in order that low initial friction may be secured.

Recording Mechanism.

When properly and carefully made, the recording mechanism is not subject to the variations in friction which occur in the bearing, and it can therefore be much more completely compensated for by means of the light load adjustment device of the meter. Only machine cut gears should be used in the construction of the recording mechanism, and during the course of manufacture every precaution should be taken to see that the gears and their bearings are in perfect condition and free from all burrs; even the slightest burr or imperfection in the individual gears will prove to be a source of friction variation, and as some of the gears move very slowly and as friction variation would only appear when the imperfect portion was in mesh, the only feasible way of detecting and preventing this source of future error in the meter is by rigid factory inspection of all parts which enter into the construction of the recording mechanism.

Weakening of the Permanent Magnets.

The next important factor affecting the continued accuracy of the watt-hour meter, and one of a very serious nature, is the weakening of the permanent magnets, often called the "retarding magnets." The only insurance which the purchaser has against a poor grade of permanent magnet is the ability and the experience of the manufacturer. It sometimes happens that meters, especially for switchboard service, are installed where they are subjected to the influence of powerful "stray fields" which may be set up, due to the proximity of wires or bus-bars carrying heavy currents. To nullify the effects of such stray fields on the retarding magnets, some manufacturers arrange the magnets astatically, that is, they are placed so that any stray field which will tend to weaken one magnet will correspondingly strengthen another, and vice versa.

Creeping.

Under the same category as fast meters comes the "creeping" of meters. It is sometimes found that meters will run slowly, or "creep" when there is no current flowing in the series fields, the potential circuit alone, being energized. This is due to the light load adjustment exerting more than enough torque to overcome the friction, and may be due to one or more causes. The light load adjustment may be so set that it just compensates for the initial friction and the meter then installed where it is subject to continual vibration, under which condition, the "friction torque" is reduced and the meter will creep. Again, the meter may be on a circuit where the voltage is above normal, which will tend to produce creeping. As a general rule, meters are so adjusted at the factory as to allow for a range of several per cent in voltage without causing creeping; such practice is to be recommended, as the slight benefit to be derived from having the friction completely compensated for is more than counterbalanced by the trouble due to creeping when such fine adjustments are made.

Overmetering.

Another frequent and easily avoidable source of loss to the distributing company is "over-metering." It often happens that in the case of public buildings, theaters and other places where there is a large "connected" load, and where for a greater part of the time only a small part of this connected load is actually taking current, that one large meter of sufficient capacity to take care of the entire installation is employed. When this is done the large meter will operate the majority of the time on light load, and for a considerable portion of the time it may be operating on very light loads, and since no commercial meter can be relied upon to continuously record such light loads with the same accuracy as at or near full load, there will result a considerable loss from the practice of "overmetering." It is often much better to install a smaller meter to take care of such loads, even at the risk of an occasional burn-out. Practically all standard meters will carry a considerable overload for short periods, and will carry as much or more than 25% overload continuously when located in cool, dry places. It is not recommended that meters be worked at overloads continuously, but in many instances it will be economy to have them work at overloads during the period of maximum demand. By exercising a little judgment a meter can be so selected that it will never be excessively overloaded, but which will be small enough to give a fair degree of accuracy during the light load period.

Where the ratio of the connected load to the average actual load is large, it is better to subdivide the

circuits and install two or more meters than to attempt to handle the entire load on one meter. In this way it can be so arranged that while there is no danger of a meter being severely overloaded, it will still be small enough to accurately record the power during the light load period.

General Construction.

The different types of meters will be dealt with separately hereafter, therefore we will take up at this point the various parts which are common to all types.

Frames and Covers: The supporting frames to which the mechanism is secured should be rigidly constructed from a mechanical standpoint, and the material used should be non-magnetic. The covers should be of sufficient rigidity to protect the meter from ordinary mechanical injury, and should also be light; the composition known as "white metal" is a good material,

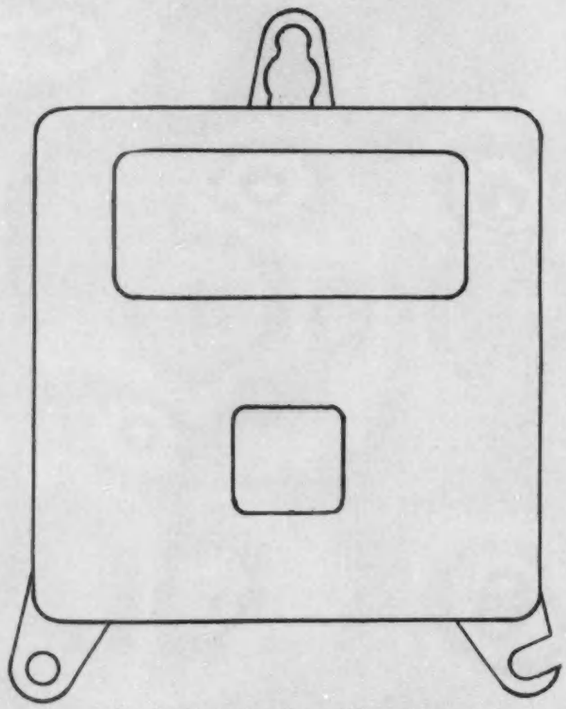


Fig. 1. Supporting Lugs of Base Frame.

being used either in its natural finish or with a coating of dull black japan. In some cases glass is used for the covers so that all working parts of the meter may be superficially inspected without removing the cover. For switchboard meters, glass is a satisfactory material for the covers, but for ordinary house type meters the metal covers are to be recommended; glass covers, exposing all parts of the interior to view, may tend to invite tampering by unauthorized persons. The internal frame which actually supports the bearings and other parts of the meter proper should also be made of non-magnetic material. In the ordinary type of "commutating" meter the construction of the internal frame is such that when used on alternating currents it is often the case that heavy eddy currents may be induced in the frame by the rapid reversals of the "projected" field. Such eddy currents cause undue heating, and to obviate this some manufacturers split the frame and insert a piece of fibre or other insulating material.

The base frame is usually furnished with three supporting lugs as shown in Fig. 1, the top lug being key-holed and the lower right hand one slotted, thus allowing the meter to be rapidly hung in place. It can then be properly levelled and set and the supporting screws driven home.

The removable covers are usually held in position by two or more studs which are fastened to the base frame and which project up through the covers; wing-nuts having holes through their bodies, through which seal wires may be passed, are used on the studs to securely hold the covers in place. The groove in the base frame into which the covers fit, should be provided with felt gaskets to exclude dust, moisture and insects from the interior of the meter. The holes for the entrance and exit of service wires should also be provided with a dust proof feature, and the dial window should be set in putty or other suitable material.

The Top Bearing: The top bearing of a meter is necessarily simple, as it does not have to support any weight, but simply acts as a guide bearing, and may be the same as or similar to either of the two types shown in Fig. 2.

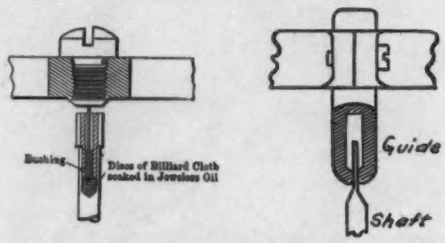


Fig. 2. Types of Top Bearing.

The Shaft: The shaft should be made as light as is consistent with good design, and is usually made of steel approximately ⅛-in. in diameter, some manufacturers using a solid shaft, and others a tubular form. At the top of the shaft is mounted the "worm" gear which transmits the motion of the shaft to the recording mechanism. There are two general methods of constructing the worm; one consists of cutting it directly into the steel shaft, the other method being to mount a worm of composition material in the end of the shaft. This latter method possesses the advantage of allowing the use of a non-rusting material. On the lower extremity of the shaft is mounted the removable pivot.

Discs: Until several years ago, the meter discs were made almost exclusively of copper on account of its high conductivity, but aluminum has practically superseded copper for this purpose, due to its lighter weight. An aluminum disc having the same conductivity as a copper disc will weigh only about 48% as much as the copper. Therefore the aluminum, though of greater thickness, is much more desirable. The question is often asked: "Why are most meter discs roughened or covered with little holes which resemble prick-punch marks?" This has nothing whatever to do with the electrical characteristics of the meter, as is sometimes supposed, but simply results from a factory method of producing a plane surface. The disc is placed on a heavy metal block, and a weight having a roughened surface is allowed to fall upon the disc, thus producing the peculiar marking. It has been

found that this process eliminates any trouble which may be due to the warping of the disc.

The Lower Bearing: There are at the present time two general types of lower bearings in use; the pivot and jewel type as shown in Fig. 3, and the ball and jewel type as shown in Fig. 4. The ball bearing is relatively a new departure, but in reality it is essentially a "pivot" bearing also, and as far as the comparative friction is concerned, they are, it is safe to say, about equal. So long as the ball remains perfectly smooth and free from rust it serves its purpose admirably.

Jewels: It has been found that there are but two kinds of jewels which are satisfactory for use in the lower bearings of meters, they being the diamond and the selected eastern sapphire. In self-contained meters, up to and including 50 k. w. capacity, the

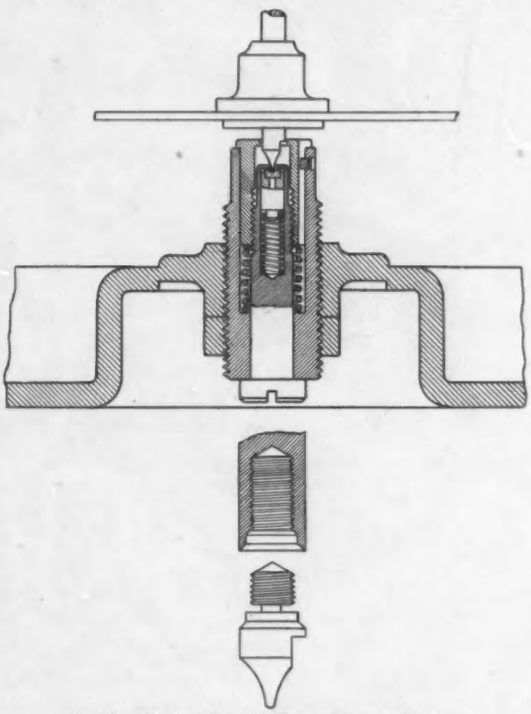


Fig. 3. Pivot and Jewel Type of Lower Bearing.

sapphire is generally used to the best advantage; above this value, on account of the greater weight of the moving element, it is advisable to use the diamond, because of its unequalled hardness. Where great accuracy is desired in the case of switchboard meters in central stations, it is often desirable to use diamond jewels in meters of as small a capacity as 5 amperes. In all cases, the jewel should be carefully selected, ground and polished, and should be free from all flaws. It has been noted that under normal conditions, the average sapphire jewel will stand as much or more than 600,000 revolutions of the shaft, and in some cases the diamond jewel has lasted for as many as 35,000,000 revolutions of the shaft. These values, however, are extremely variable and depend to a great extent upon the conditions and care under which the meter operates.

The Retarding Magnets: It is of the utmost importance that the strength of the retarding magnets be as permanent as is possible to make them, since their retarding or "dragging" effect is proportional to the square of their magnetic strength. Therefore a slight change in the strength will have an appreciable effect upon the speed of the disc. Much depends upon the physical properties of the steel from which the magnets are manufactured, and the most rigid inspection, by both chemical and physical analyses should be made of each lot of steel before it is treated for use as meter magnets. The manufacturer, after he has given the steel a special process of treatment, hardens, forms and magnetizes the product. The completed magnet is then subjected to hammer blows to detect any mechanical imperfections, and if it should fail to "ring true" is rejected. It then undergoes an artificial aging process; accurate measurements of magnetic strength being made at frequent intervals. It is then laid away for several months after which

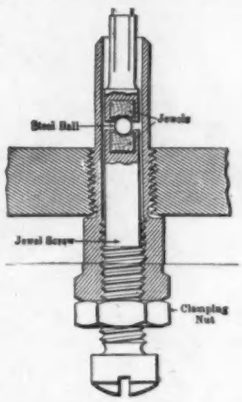


Fig. 4. Ball and Jewel Type of Lower Bearing.

the strength is again measured and if this latter measurement differs in the least from its strength when first laid away it is discarded.

A very successful process of magnetizing meter magnets consists in slipping the completed form over a copper bar, through which a heavy current of electricity (many thousands of amperes) is passed momentarily. In this way a great number of forms can be magnetized at the same time, and a uniform strength produced. Great care is taken in the manuture of the permanent magnets, and as a rule the results are very satisfactory.

The Recording Mechanism: As previously pointed out, the recording mechanism should be manufactured with the greatest care, and rigid factory inspection is practically the only safeguard against imperfections. Meters are often placed in such positions that the meter reader will encounter reflected light, and for this reason it will generally be found that a dial of unglazed material will be less difficult to read under all conditions. The recording mechanism should be so constructed and provided with such dowel pins that it can be removed from the meter at any time and then replaced in the exact position from which it was originally taken without disturbing in the least the mesh of the worm with the first gear.

From the foregoing description of the general construction, a very good idea can be gathered as to the mechanical requirements of a good meter; a study of the subsequent chapters treat of the electrical characteristics.

(To be continued.)

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R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG

604 MISSION STREET, SAN FRANCISCO

TELEPHONE - - - - - - - - - KEARNY 918

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FOUNDED 1887 AS THE
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Patent Office Reform

Rumors are rife as to reform in the Patent Office. Inventors, manufacturers and capitalists agree that some change is necessary to eliminate existing uncertainty as to the validity and scope of patents granted. Under present conditions no patent can be considered binding until it has been finally passed upon by the courts. This involves vexatious and costly litigation, and contravenes the primary intention of the patent laws that invention should be encouraged.

The efficiency of the Patent Office closely concerns commercial progress and any remedy that facilitates finality of patent decision advances our industrial welfare. Among the many causes assigned for American success, not the least is the characteristic habit of crystalizing imagination into invention. The United States Patent Office will soon grant its millionth patent, the annual crop now being close to forty thousand. In 1909 the proverbial ingenuity of the Connecticut Yankee gave this State the first place in the per capita inventive output, there being one invention for every 881 inhabitants. It is significant that, except for the District of Columbia, the Western States of California, Washington, Nevada and Colorado are, respectively, next in order. Oregon and Utah are twelfth and fourteenth in the list. South Carolina has but one inventor to every 19,424 inhabitants.

From the report of the Commissioner of Patents for 1909 we also learn that he is keenly aware of the defects in the patent system as it is. His criticism is constructive in that it contains certain recommendations for betterment. Less than one-half of the listed patents have been properly classified and the examiners have difficulty in definitely determining the novelty of the new inventions. The Commissioner urges that the inadequate force now available for this work be augmented so that it can be quickly completed.

The Commissioner furthermore recommends the abolishment of the present dual course of appeals, with its attendant delay and expense, and the substitution therefor of a measure giving jurisdiction to a single appellate tribunal, from which further appeals can be carried to the Court of Appeals of the District of Columbia. He also endorses the efforts of the American Bar Association to establish a Court of Patent Appeals in lieu of the latter. Bills to this effect are now before Congress.

Commissioner Moore also suggests the repeal of the law relating to caveats on the ground that it gives no real protection against infringement. The advantages that do accrue under the caveat provision are among those embraced by filing an application for patents. His final plea for more commodious quarters for the patent office is one that should be granted, especially as this department is one of the few that are run at a profit and can be well housed by expending the seven million dollars that it has turned into the Treasury since its establishment.

PERSONALS.

M. M. O'Shaughnessy is in Southern California on hydraulic engineering business.

Mr. Ralston of the Ralston Electric Supply Company of Albany, Ore., was a recent visitor in San Francisco.

Frank Dabney has been appointed controller of the Seattle Electric Company and subsidiary companies at Seattle, Wash.

F. L. McGillan, manager of the California Pole & Piling Company, left San Francisco last week on a trip to Everett, Wash.

T. B. Hunter, president of the Monterey Water Company of Monterey, Cal., was a visitor in San Francisco during the past week.

R. B. Elder, district manager of the Allis-Chalmers Company, has returned to San Francisco from a business trip to Los Angeles.

C. O. Poole, who was for some time engineer for the Nevada-California Power Company, was in San Francisco from Los Angeles this week.

H. Krantz of the H. Krantz Mfg. Company of Brooklyn, N. Y., is visiting the Pacific Coast offices of the company, Otis & Squires of San Francisco.

A. D. Miller, formerly manager of the Reno Traction Company of Reno, Nevada, has been made manager of the Central California Traction Company of Stockton.

H. H. Manley, who is connected with the management of the Crescent City Light, Water and Power Company at Crescent City, Cal., is a visitor in San Francisco.

F. W. Siemon, treasurer of the Westinghouse Electric & Manufacturing Company, of Pittsburg, has gone to Portland, Ore., after spending several days in San Francisco.

K. G. Dunn, engineer, of Hunt, Mirk & Co. of San Francisco, is in the Northwest on business connected with the Westinghouse Machine Company's steam turbine line.

W. P. Hammon, president of the California-Nevada Electric Power Company, with offices in San Francisco, has gone East on business connected with his large water power and mining interests.

A. W. Q. Birtwell, assistant treasurer of the Tacoma Railway and Power Company, and the Puget Sound Electric Railway, Tacoma, Wash., has been appointed assistant treasurer of the Seattle Electric Company.

George C. Graham, formerly master mechanic of the United Traction Company, of Albany, N. Y., is now superintendent of car equipment and shops of the Los Angeles-Pacific Company, Los Angeles, Cal.

George Henry, Jr., engineer with the Pelton Water Wheel Company's San Francisco office, has returned from a trip through the Pacific Northwest where he found good business conditions in engineering lines.

Francis Hodgkinson, chief engineer of the turbine department of the Westinghouse Machine Company of Pittsburg, is in San Francisco from the East via Portland. This is Mr. Hodgkinson's first visit to the company's San Francisco office. He will soon visit Los Angeles.

W. E. Wilmot, formerly auditor of the Seattle Electric Company, has been appointed assistant treasurer of the Puget Sound Electric Railway and the Tacoma Railway and Power Company, Tacoma, Wash., to succeed Mr. A. Q. W. Birtwell, who has been appointed assistant treasurer of the Seattle Electric Company.

James M. Wakeman has resigned as vice-president of the McGraw Publishing Company, of New York City, in order to take a needed rest. He has been succeeded by Hugh M. Wilson, formerly publisher of the Electric Railway Review.

C. L. Cory, electrical engineer, read a paper on "The Public Service Corporation" at the monthly meeting of the American Institute of Electrical Engineers, held February 25th in the Home Telephone Building in San Francisco. An interesting discussion of the subject by members followed.

Delos A. Chappelle, general manager of the Nevada-California Power Company, was in San Francisco this week, with his consulting engineer, C. O. Poole, of Manifold & Poole, of Los Angeles, closing contracts for the electric equipment of a new power-house on the Bishop Creek development in Nevada.

Bertram M. Downs, vice-president of the Brookfield Glass Company of New York City is looking over Pacific Coast conditions, leaving San Francisco this week for Seattle. Mr. Downs reports that this company has a large reserve stock to care for the great increase in business which Eastern demand shows is impending.

TRADE NOTES.

The Westinghouse Electric & Manufacturing Company has secured the contract for the electric motor equipment for a gold dredge.

The John R. Cole Co. of San Francisco have opened up a branch office at Los Angeles at 221 Grosse Building, in charge of Geo. A. Cole.

The Pelton Water Wheel Company of San Francisco has closed a contract for two 600-h. p. turbine wheels for the Yuba Construction Company. These will be direct connected to generators which will furnish current for the operation of a gold dredge which is to be built in Colombia, where the Yuba Company has mining interests.

Hunt, Mirk & Co. of San Francisco during the past week sold the Los Angeles Gas & Electric Company an additional Westinghouse-Parsons turbo-generator, rated at 4000-kw., 60 cycles. The company already has in operation a 3000-kw. generating set of the same make. Additional boilers and auxiliary apparatus are yet to be contracted for.

The H. Mueller Mfg. Company of Decatur, Illinois, have established an agency in California, with Mr. C. D. Saunders as manager. He will be located in San Francisco. Mr. Saunders' territory will include California and Nevada. It is contemplated, at a later date, to establish a branch house in San Francisco for the convenience of the western trade.

The Westinghouse Machine Company has sold an additional 1500 k. w. 2300 volt 2-phase 60 cycle Westinghouse-Parsons turbo-generator to the Hawaiian Electric Company for use in the Honolulu central station. Both lighting and power services are supplied. The 750 k. w. Westinghouse-Parsons turbo-generator set that was supplied some time ago gave such satisfaction that the present order was given.

The General Electric has just sold the Yuba Construction Company complete electrical equipment for a big gold dredge of 300 h. p. digger-capacity, which is to be built and operated near Boise City, Idaho. The list of 200-volt induction motors to be supplied is as follows: One 300-h. p. digger motor; 150-h. p. high-pressure pump motor; 75-h. p. low-pressure pump motor; 25-h. p. auxiliary pump motor; 75-h. p. sand pump motor; 75-h. p. stacker motor; 35-h. p. winch motor. The contract also calls for one 2-h. p., 110-volt tool motor, two 7½-kw. lighting transformers and a 7-panel switchboard, with the necessary cables to connect the dredge with the power line.

NEWS OF THE STATIONARY ENGINEERS

PREAMBLE.—This Association shall at no time be used for the furtherance of strikes, or for the purpose of interfering in any way between its members and their employers in regard to wages; recognizing the identity of interests between employer and employe, and not countenancing any project or enterprise that will interfere with perfect harmony between them.

Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the business of the Association, and at all times preference shall be given to the education of engineers, and to securing the enactment of engineers' license laws in order to prevent the destruction of life and property in the generation and transmission of steam as a motive power.

California.

No. 1. San Francisco, Thursday, 172 Golden Gate Ave. Pres., P. L. Ennor. Sec., Herman Noethig, 816 York St.

No. 2. Los Angeles. Friday, Eagles' Hall, 116½ E. Third St. Pres., J. F. Connell. Cor. Sec., W. T. W., Curl, 4103 Dalton Ave.

No. 3. San Francisco. Wednesday, Merchants' Exchange Bldg. Sec. David Thomas, 439 Merchants' Exchange Bldg.

No. 5. Santa Barbara. Geo. W. Stevens, 2417 Fletcher Ave., R. R. No. 2.

No. 6. San Jose. Wednesday. Pres., W. A. Wilson, Sec., Lea Davis, 350 N. 9th St.

No. 7. Fresno. Pres., A. G. Rose. Sec., E. F. Fitzgerald, Box 651.

No. 8. Stockton. Thursday, Masonic Hall. Sec., S. Bunch, 626 E. Channel St. Pres., H. Eberhard.

Oregon.

No. 1. Portland. Wednesday, J. D. Asher, Portland Hotel. Pres., B. W. Slocum.

No. 2. Salem. A. L. Brown, Box 166.

Washington.

No. 2. Tacoma. Friday, 913½ Tacoma Ave. Pres., Geo. E. Bowman. Sec., Thos. L. Keeley, 3727 Ferdinand St., N., Whitworth Sta.

No. 4. Spokane. Tuesday. Pres., Frank Teed. Sec., J. Thos. Greeley, 0601½ Cincinnati St.

No. 6. Seattle. Saturday, 1420 2d Ave. Pres., H. R. Leigh. Sec., J. C. Miller, 1600 Yesler Way.

Practical letters from engineers and news items of general interest are always welcome. Write your items regardless of style. Communications should be addressed to the Steam Engineering Editor.

PRACTICAL MECHANICS.

Paper No. 8.

Transmission of Pure Rotation by Means of Belts and Ropes—In this paper we shall consider the case of transmission by wrapping connectors on belt gearing. This is one of the most important forms of mechanical power transmission. It is reliable, simple, comparatively inexpensive, and capable of extension to considerable distance between driver and follower. It also lends itself to a variety of different applications; so much so that it is probably our most useful form of mechanical transmission.

In this classification are included belts, bands and chains working over either pulleys or sprocket wheels for continuous motion, and over cams also where the motion is limited. Where the motion is not continuous the velocity-ratio may be either constant or variable. The applications of variable-ratio belt transmission are not of sufficient importance to be of interest to the engineer and will therefore be passed over with the general statement: The velocity-ratio is always equal to the inverse ratio of the segments of the line of centers; counting from the centers of motion to the intersection with the line of action—that is the belt or rope. In Fig. 9 this may be stated $\frac{\omega_b}{\omega_a} = \frac{BC}{AC}$ where ω_a and ω_b are the angular velocity of A and B respectively. This will be equally true if c falls between A and B as it would do in the event that the belts crossed and the directions of rotation of driver and follower were opposite. The velocity ratio may aso be determined from the ratio of the perpendiculars AD and BE drawn from the centers of rotation to the line of contact; thus $\frac{\omega_b}{\omega_a} = \frac{BE}{AD}$ This is of course obvious from the similarity of triangles. In practice, where a given shaft is to be driven by belt from a driving shaft of known speed, a definite belt speed is determined by a knowledge of the power to be transmitted, the distance between shafts, and such other conditions as exist to affect the belting. The belt speed and revolutions per minute being known, the pulley diameter is easily found by the formula: Belt speed in feet per minute equals revolutions per minute times the circumference in feet or $V = \frac{\text{r. p. m. } \pi D}{12}$ from which $D = \frac{12\ V}{\pi \text{ r. p. m.}}$

If the driving pulley and speed of the driving shaft are given the size of pulley necessary to give a certain speed to the driven shaft may be found by direct proportion. Thus in Fig. 9. Diameter of B x speed of B equals diameter of A times speed of A. That is, the product of diameter into revolutions per minute is constant.

Taking up now the constant velocity-ratio we shall consider the three cases of axis relation as has been done heretofore.

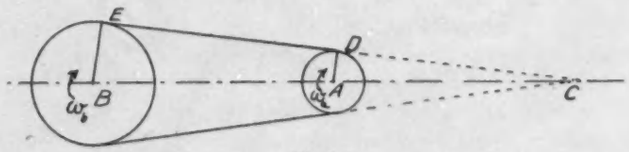


Fig. 9.

1—Axes of rotation parallel either in the same straight line or otherwise.

Where the axes are in the same straight line and their regular velocities are the same, the direct coupling is to be preferred to any other form of transmission; but if a different velocity ratio is desired then belting and a counter shaft with two pulleys could be used. As this would then become a case of parallel axes not in line we shall consider that condition at some length.

Ordinary Belting—The belt may be either a leather strap or a woven texture with a rubber filling; or a series of links connected with pins. Belts are flat or round. The latter being often employed for small work. If other than flat the belt runs in a groove of V shape. The usual belt for power transmission is flat, however, and runs on nearly flat pulleys, a slight double cone surface being given them to assist in keeping the belt centered. A belt will always try to climb to the highest point, or to the greatest diameter, and hence the center crowning attracts both sides of the belt to it and so keeps it on the pulley.

The exact velocity-ratio where fairly thick belting is employed is hard to be found for two reasons. The belt thickness adds appreciably to the pulley diameter and the unavoidable elasticity of the belt—its contraction on the driving pulley and expansion on the driven pulley causes an apparent slip. It is this creeping action that keeps the surfaces of pulley polished.

PROBLEMS DISCUSSED BY CALIFORNIA NO. 3. N. A. S. E.

BOILER SETTINGS.—Has reinforced concrete ever been used for boiler setting, and if so how does it compare with brick? How does the cost compare?

Concrete has not been used for a complete boiler setting because it will not endure the high temperature to be met. Under such extremes of temperature as are met in boiler settings it will soon disintegrate and actually crumble to dust. This is due to the expansion and contraction as well as to a deterioration in the cement. Reinforced concrete would be as expensive if not more so than brick. A fire brick lining would be required in any event and reinforcement would be necessary.

PACKING.—What is the advantage if any of cutting packing on a bevel rather than square across?

There is no appreciable advantage. It may result in preventing leakage at the joint but as each ring "breaks joints"

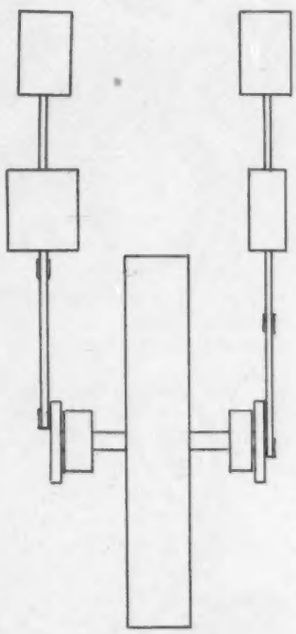
with the others this is not important. It would be easier to insert a packing ring so cut.

INDICATOR PIPING.—What is the advantage of having two indicators with the consequent short piping to each, over a single indicator with the usual three-way valve and double piping to it?

Where a single indicator is used there may be a slight displacement of the card due to the slight lag of the steam in traversing the long piping. The card itself would not be distorted but might be shifted along the sheet slightly so that a longer clearance than actually existed would be shown.

Where the load is varying greatly there may be a decided change in the performance during the interval between taking the two cards on a single indicator where, with two indicators, the cards could be taken approximately simultaneously and thus the true load at any instant would be obtainable.

FLYWHEEL.—In a direct connected cross compound pumping engine as shown in the attached cut what is the function of the flywheel?



The fly wheel in this case acts as a regulator on the speed holding the angular velocity constant at all parts of the revolution. Thus at the beginning of the stroke the initial steam pressure in the h. p. cylinder is greatly in excess of the hydraulic pressure opposing it. At this part of the stroke then the fly wheel is storing up energy. Out on the expansion line there is a point where the above two pressures are equal and opposite. Here the flywheel commences to return its energy back to the shaft. Of course the L. P. cylinder would be exciting energy when the h. p. were on the low end of the expansion line but the variation in available surplus energy would be considerable in the absence of the flywheel. That the flywheel actually does cause a continually varying supply of energy to be transmitted into and out of the shaft is evidenced by the very pronounced wear on one side of the crank pin. At the beginning of the stroke the pin receives the thrust from the connecting rod and later when the fly wheel returns that thrust the crank has so turned that the same side of the pin now receives the pull. It is thus worn out of round in this spot. Flywheels have been known to creep on the shaft during portions of the revolution and could only be prevented by heating the hub bolts and setting them up white hot so that their contraction gave enormous gripping to the shaft.

CO-OPERATIVE CO-OPERATION.

BY ANDREW CARRIGAN.

In a treatise on co-operation, from our standpoint, we must choose from its various definitions the following: "Joint action"; "a working together," as derived from verb "co-operate"—"to work together for a common end." As a synonym of "co-operation," we find the word "aid" and its definition "to promote the success of." The word "aid" has many definitions and many synonyms, but we have selected this one rather than the broader term "help," as this might be construed in a charity sense that would be repugnant to every self-reliant American business man.

Co-operation, being a joint action, almost invariably follows a condition of necessity; this necessity may be political, fraternal or financial. The present discourse is certainly not political; it undoubtedly is financial, but I hope, above all, that we can call it fraternal, for business is cold enough at its best, and a touch of fraternity goes far indeed to add a pleasure to the everyday routine of an everyday business life. As to the necessity of co-operation, stop and consider the business conditions of today as compared with twenty to thirty years ago. Then, co-operation was as unknown as it was unnecessary. Competition was limited, and on the Pacific Coast was largely confined to "Have you got the goods?" not "What is your price?" In those days, the personal equation in business counted far more than now, so that of necessity we must adopt the "live and let live" idea, and that idea is born of co-operation. This does not mean co-operation; it means nothing in the restraint of trade, but it means only the development of a higher business ideal, the curbing of our business jealousies; above all, it means competition on a higher plane. All of this refers particularly to those of us who are competitors. We are then led to the subject of co-operation between jobbers and manufacturers or their representatives, and between the jobber and the retailer or contractor. Time and custom have evolved the most economical channel of distribution, namely: first, the manufacturers who create, each in himself, a limited line of commodities, too limited for economical distribution to the retailer or consumer; second, the jobber who stocks the various lines of many manufacturers, and, third, the retailer or contractor who draws from such assembled stocks and sells to the consumer, whether in the remote country places, or to the householder in the towns and cities, and with whom the jobber or manufacturer cannot come in contact.

While co-operation may not be essential to the mere existence of any of these classes, it is certainly essential to their success and happiness, and we are all entitled to our fair share of those commodities in life.

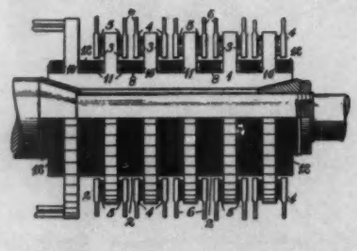
Thus far we have dealt with the cause and necessity of co-operation, and we come now to the resultant action of co-operation, which may be defined as reciprocity and the final result of all success. To reciprocate is "to give and take mutually"; also, "to give something in return for." Reciprocity with its "give and take" motto must be our keynote; we cannot "have our cake and eat it too"; we cannot hope to be "all things to all men." Let us endeavor, then, to "live and let live," each in his own sphere of action, to the end that success, that for which we all strive may be ours.

G. E. 210 RAILWAY MOTOR.

Bulletin No. 4715, recently issued by the General Electric Company describes the company's G.E.-210 Railway Motor. The motor is a 70 h. p., 600 volt motor of substantial construction and having brush holder and field coil supports. The bulletin enters into a detailed description of this motor and contains a speed table, characteristic curves and dimension diagrams.

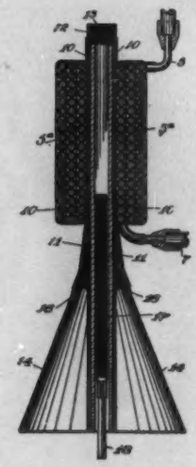
PATENTS

949,103. Commutator for Dynamo-Electric Machines. Miles Walker, Manchester, England, assignor to Westinghouse Electric & Manufacturing Company. A commutator cylinder comprising insulated commutator bars and having a series of



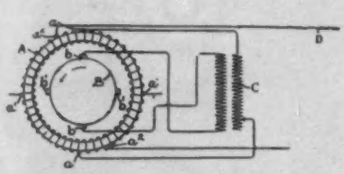
relatively deep peripheral grooves the side walls of which constitute plane contact surfaces, and clamping bands located in the bottoms of said grooves to hold the commutator bars against displacement.

949,184. Insulator for High-Potential Circuits. Joseph N. Kelman, Los Angeles, Cal. An insulator consisting of a plurality of spreading members and a tube, said spreading mem-



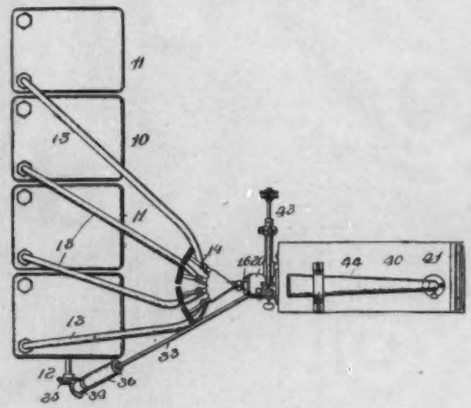
bers and said tube being constituted of laminae or layers of flexible fabric covered and impregnated with insulating varnish, said insulator having a rigid central insulating tube.

949,320. Variable-Frequency Generator. Giuseppe Faccioli, Schenectady, N. Y., assignor to General Electric Company. A variable-frequency, self-exciting alternating current generator having stator and rotor windings, one of said windings being provided with a commutator and brushes, a transformer having primary and secondary leads connected to



the rotor and stator windings respectively, means for varying the ratio of transformation of said transformer, and a load-circuit connected to points on the stator winding displaced from the points on said winding to which the transformer leads are connected.

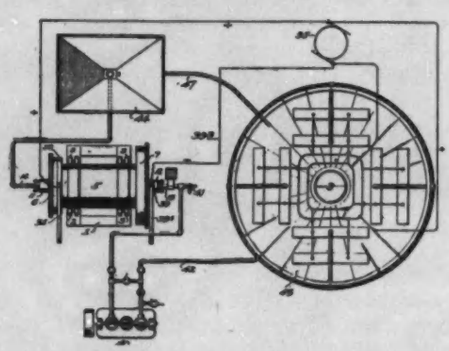
949,129. Engine Indicating Apparatus. Frederick Purdy, Kenosha, Wis., assignor of one-half to Foree Bain, La Grange, Ill. The combination with an engine, of an indicator comprising a receptive surface and an applicator for directing a tracing medium upon said receptive surface, one rotatable relative to the other about the center of indication, the rotative



part having connection with the engine for rotation in consonance with the cycles of operation of the engine, and said applicator being movable to radially deflect the tracing medium upon the receptive surface to vary its distance from the center of indication, and means responsive to pressure within the engine for so moving the applicator.

949,506. Art of Rejuvenating Storage Batteries. Alfred O. Tate, Toronto, Ontario, Canada. The method or process of rejuvenating or renewing a depleted storage battery cell of the applied oxid type which consists in electrolytically reducing the oxidized anodes and their applied oxid to metallic lead and simultaneously electrolytically oxidizing the spongy applied metallic lead of the cathodes until said anodes and cathodes shall have assumed their normal or original efficiency.

949,016. Electrolytic Apparatus for Recovering Metals from Solutions. Wilbur A. Hendryx, Denver, Colo. In an electrolytic depositing apparatus, the combination with a tank provided with a supply of a chemical ore pulp solution, a pump connected to said tank, a revolving electrolytic depos-

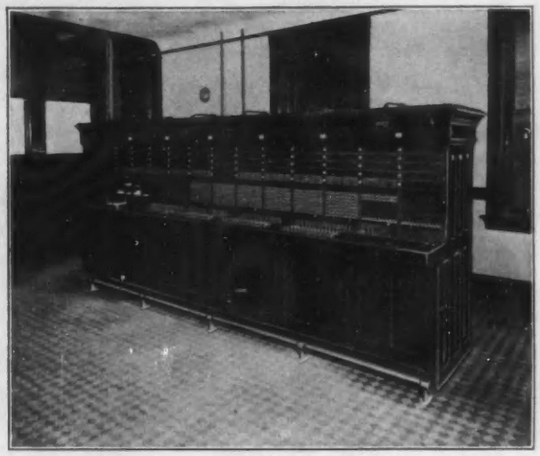


iting device connected to said pump, having an anode comprised of a suitable metal in a granulated or shot form, and a cathode comprised of a suitable metal in a granulated or shot form, and means including a pipe for conveying the solution from said filtering device to said tank, as specified.

INDUSTRIAL

KELLOGG TELEPHONES IN ARIZONA.

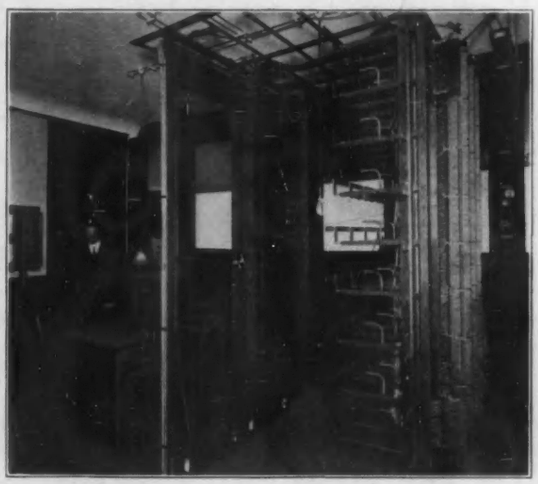
Three flourishing little cities in Arizona—Prescott, Globe and Bisbee—have recently installed common battery multiple switchboards. These are the 4-party harmonic multiple type, and the only up-to-date common battery multiple plants in the territory. In fact, the territory has only one other common battery plant. Although thinly populated, the towns and



Front View, Prescott Switchboard.

cities of that section are making a remarkable growth, and the citizens are wide awake and demand the best.

All three plants were equipped and installed by the Kellogg Switchboard & Supply Co. In the illustrations the Prescott equipment is shown. This board is in two multiple sections, each section being six-panel, two position, with a capacity of 3000 multiple jacks. Golden oak is the material used

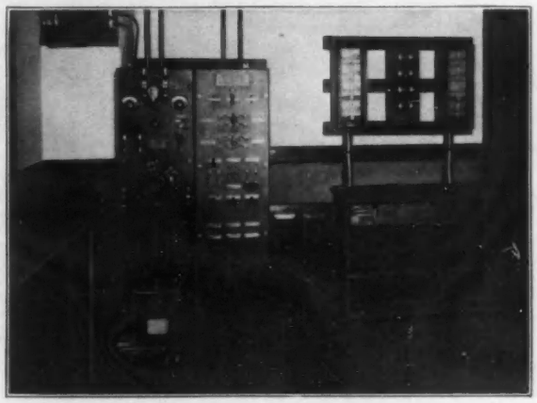


Distributing Frame and Wire-Chief's Desk.

throughout in the cabinet work. The board is equipped with 520 C. B. lamp signal line circuits and 20 rural and toll lines. Three operators handle the city lines, while a fourth has the rural and toll lines.

Fifteen standard Kellogg, double supervisory cord circuits comprises the equipment for each regular subscriber's operator, and ready means of testing cord and line circuits are provided. The standard Kellogg breast plate transmitter and head receiver is used by each operator. A matter deserving special attention is the manner of lighting. Each section is lighted by electric lamps placed in trough reflectors. The wiring for these lamps is run in iron conduits throughout the board and reduces fire risks to a minimum.

The standard wire-chief's desk is built in convenient form for testing work. The equipment is placed so that top of the desk is free for writing or other work, and is free from cords and plugs, all circuits terminating in keys.



Power Switchboard and Pole Changers.

The power plant is most complete, being furnished with duplicate sets of storage batteries and duplicate ringing equipment. Two sets of four frequency vibrating pole changer and transformer sets make up the ringing equipment. This equipment is universally used in Kellogg four-party plants with the greatest satisfaction. The storage batteries are charged by means of a mercury arc rectifier, accepted generally by telephone engineers as the most economical and efficient method of charging storage batteries from alternating current.

ELEVATOR CONTROLLERS.

The Cutler-Hammer Mfg. Co. of Milwaukee, has recently redesigned its entire line of electric elevator controllers. As now constituted the line embraces three types of full magnet controllers for direct current elevators and two full magnet controllers for alternating current, the various types providing suitable contol for high speed and moderate speed passenger elevators and a simplified form of full magnet control for freight elevators.

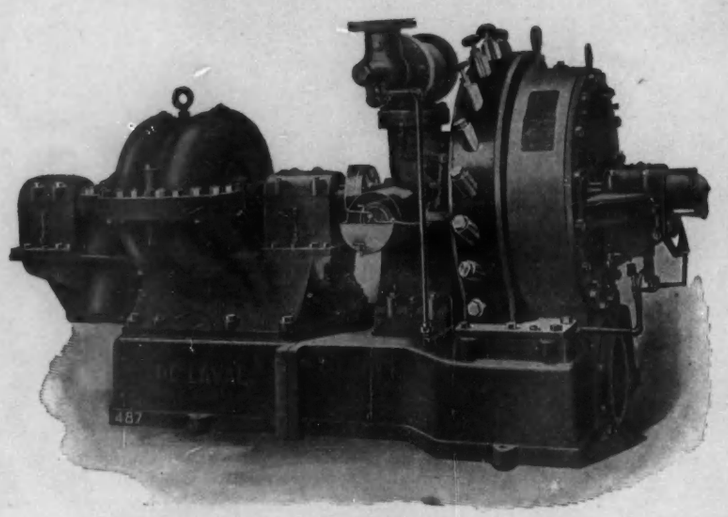
Eight different types of direct current, semi-magnet controllers are provided and four semi-magnet controllers for alternating current. The line includes, also, mechanically operated controllers suitable for use where the voltage of the line is extremely variable, reversing and non-reversing controllers for belt driven freight elevators, and a compact drum type controller for use with sidewalk lifts.

The Cutler-Hammer line of alternating current controllers is particularly interesting as indicating the increasing use of the induction motor in elevator service. Up to within a comparatively short time ago direct current motors were almost invariably used for this class of work, but recent developments in the controller art have made it possible to employ the full magnet system of control with alternating current motors also. It is stated that the polyphase brake solenoids used with alternating current motors operating elevators are now practically noiseless, thus eliminating the annoying humming which was formerly a serious objection to the use of alternating current controllers, particularly when installed in residences, office buildings or hospitals.

STEAM TURBINE-DRIVEN CENTRIFUGAL BOILER FEED PUMPS.

The first requisite of a boiler feed pump is the ability to give uninterrupted service while receiving little, and often unskilled, attention. For this reason the simple direct-acting pump has long held the field, in spite of its many shortcomings such as an enormous steam consumption, tendency to produce shock and vibration, unsuitability for close regulation, numerous valves, etc.

The centrifugal boiler feeder, which has lately been taken up by several of the largest steam power plants in the United States, is free of these defects and possesses several important advantages in addition. It does not endanger the pipe line by vibration, by excessive pressure, nor by shock. The inflow of water can be regulated at the boiler without reference to the pump. A centrifugal boiler feed pump contains no valves and only two packings, of quite small diameter, to be kept tight against hot water. There is no danger of breakage of pistons, cylinder heads or packing rings through loss of suction and consequent pounding. The adherents of the direct acting pump have asserted that with



Turbine Driven Centrifugal Boiler Feed Pump.

the pump in motion the operator can always be sure that water is going into the boiler, but this supposed advantage does not obtain where one or more pumps are feeding several boilers and, moreover, it is quite possible for a piston pump with one valve displaced to run steadily without forcing water into the boiler.

One thing that has retarded the introduction of the centrifugal boiler feed pump is the fact that it is not suited to reciprocating engine drive, as the comparatively low speed of the latter makes necessary a large number of stages in order to obtain the high heads required to overcome modern boiler pressure and if an attempt is made to keep down the number of stages by making the impeller large in diameter, the efficiency is seriously reduced. However, if the pump is to be driven by a steam turbine or electric motor this becomes an advantage. For instance, the impellers of the two-stage steam turbine driven pump shown by the accompanying photograph, designed to deliver 1600 gallons per minute against a head of 700 feet at 2800 revolutions per minute, are quite moderate in diameter.

Simplicity of construction and accessibility for inspection are essentials for any pump that is to be installed in a boiler room and entrusted to unskilled labor. It should be possible to get at the working and wearing parts of a pump without disturbing pipe connections. As will be noted from the accompanying photograph the casing of this pump consists of two parts only, the bottom casting and the cover casting. In the bottom casting are formed the inlet and outlet passages to the piping, while both castings contain passages leading from the delivery of the first impeller to the inlet of the second, these passages being cast in the solid metal. Smoothness and exact form of the passages are secured by the use of dry sand moulds exclusively. The top or cover casting, when raised, exposes the shaft and the impeller, that is the entire interior and all working parts of the pump, and after removing the shaft bearing caps, the impeller may be lifted out entire, so that all parts are rendered accessible by the breaking of only one packed joint, namely, that between the two halves of the main casting. The connections to the suction and discharge pipes need not be disturbed in any way. The flange of the suction opening may be seen at the end of the pump under the bearing, while the discharge opening is directed horizontally on the further side of the pump.

The bearings of a boiler feed pump destined to be operated for long periods without attention should be the best obtainable. In the present case they are all of the ring-oiled type used for electric motors and generators. They are of very ample dimensions and are supported on hollow brackets of pedestals entirely separate from the pump casting. These pedestals contain oil wells and are fitted with the usual cocks and gauge glasses.

The pump is directly driven through a flexible coupling by a steam turbine upon the same bed plate. The turbine is designed to receive steam at 200 lbs. gauge pressure with 150 deg. F. superheat and to exhaust into open heaters. The power for operating the pump therefore costs practically nothing, as all of the energy of the steam is returned to the boiler in the feed water, including even that expended as work and friction in the pump and turbine.

The governor of the turbine is an interesting feature. The pump can be controlled by an ordinary pump governor, of either the constant or excess pressure type, inserted in the steam line ahead of the turbine, the turbine governor acting merely as a maximum speed limit. The turbine governor is driven by a worm gear from the shaft at a speed of 900 revolutions per minute, making possible the use of a heavy, powerful construction. As an additional guarantee against excessive speed, an emergency governor is fitted to the end of the shaft. In case of overspeeding this governor trips a lever, which relieves steam pressure from under a piston controlling the emergency valve in the steam pipe outside of the turbine. The pipes connecting the emergency governor and the emergency valve may be seen in the picture. Even in the case of failure of both governors the turbine could suffer only minor damage, as the wheel is so designed that long before its limit of strength is reached, the buckets will fly off, upon which the disc will come to rest. The single solid disc of this turbine is comparatively easy to balance, although it is quite difficult to balance a shaft with several discs threaded on it.

In a turbine of this type the best steam economy is secured when the nozzles are receiving steam at the full pressure: In order to make possible the running of the nozzles at the highest efficiency at all times, including periods of light load, it is only necessary to supply hand or automatically operated valves for shutting off one or more nozzles as may be required. Such valves may be observed at the top of the machine in the photograph.

The machine here described and illustrated is one of two shipped to the Detroit Edison Company by the De Laval Steam Turbine Co., of Trenton, N. J. The pump has shown under test at full load an efficiency of over 60%, which considering the capacity is unusualy high. Larger pumps of this type and make have shown efficiencies above 85%.

FIELD RHEOSTATS DESIGNED FOR REMOTE CONTROL.

One of the troublesome problems in the design of switchboards has been that of finding a place for the large generator field rheostat. The General Electric Company have solved this problem by designing a rheostat, the type CR 179, which admits of remote control, the controlling switch only being located on the switchboard, while the rheostat itself is installed at any point where convenience and economy of space may dictate.

The details of its construction and the manner of operating it are clearly shown in Figs. 1 and 2. The rheostat

Fig. 1. CR 179-100 ampere ratchet driven field rheostat switch.

arm is rigidly fastened to a wheel with a toothed rim. Pawls fastened to the common core of the two magnets (AA), Fig. 2, engage the toothed rim of the wheel mentioned above and move it clock-wise or counter clock-wise.

To cut resistance into the field, close the double pole switch B to the left, energizing the left hand solenoid and causing the left hand pawl to engage the rim of the wheel, moving it in a clock-wise direction. When the solenoid core has reached its extreme point of travel, the solenoid circuit is automatically opened by the small switch C, allowing the pawl to be returned to the position midway between the solenoids by a spring, and permitting the switch C to again close,

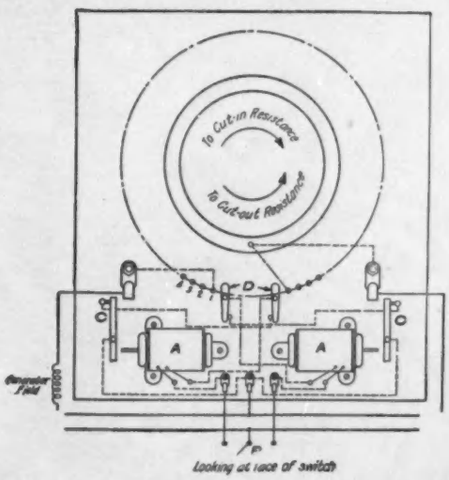


Fig. 2. Connections of CR 179 solenoid operated ratchet driven field rheostat switch.

starting anew the cycle of operations just described. This cycle of operation is repeated over and over again until switch B is opened. To cut-out resistance switch B is closed to the right, causing the same cycle of operations as described above, with the exception that the right hand solenoid is energized and the arm is driven counter clock-wise.

Each end of the switch dial is provided with a limit switch D which is automatically operated by the switch arm to open the circuit of the solenoid when the resistance is entirely cut in or out, protecting the apparatus in case the solenoid is left energized when the arm has reached its extreme point of travel. There are no high speed revolving parts which, due to their inertia, continue to cut in resistance after the controlling circuit has been opened. As compared with motor operated rheostats, this device possesses the following advantages: Costs less, admits of closer regulation of resistance, requires no attention, requires less space, is lighter in weight, and can be made self-contained. Repairs are much simpler and can be more quickly made, and the cost of maintenance is less.

NEW CATALOGUES.

Bulletin 89 from Wagner Electric Mfg. Co. gives full details regarding the Wagner type B. W. polyphase induction motor.

Bulletin No. 4689, recently issued by the General Electric Company, is devoted to the subject of Ornamental Street Lighting.

Bulletin No. 6 from the Kelman Electric & Mfg. Co., of Los Angeles, Cal., illustrates and describes High Voltage Disconnecting Switches.

Trumbull Cheer for February from the Trumbull Electric Manufacturing Company, contains the announcement of winners in the recent Lincoln penny contest.

Railway Signal Volt-Ammeter, Type S for testing direct current railway signal apparatus and similar work on telephone and telegraph circuits is described in Bulletin No. 4714 from the General Electric Company.

The Illuminating Engineering Laboratories, Welsbach Company, Gloucester, N. J., have published valuable rules suggestions and information on Welsbach Illumination in their "Gas Solicitors' Handbook," compiled by Norman Macbeth.

Worthington Turbine Pumps for high and low head service are illustrated and described in construction and operation in two interesting booklets from Henry R. Worthington, 115 Broadway, New York City. W-175 is devoted to high head turbine pumps and W-176 to centrifugal pumps for low head service.

The General Electric Company has issued a small pamphlet, No. 3907, descriptive of the G. E. Mazda lamp. This lamp is the most recent and improved development in high efficiency metal filament lamps. It represents the result of the combined research work and manufacturing experience of the laboratories and factories of the most important lamp manufacturers and inventors in the world, secured through the acquisition of the most improved processes.

In a 128 page booklet just issued by the Cutler-Hammer Mfg. Co., of Milwaukee, the subject of the control of electrically operated elevators is fully covered. The first section of the booklet contains illustrated descriptions of full magnet and semi-magnet direct current controllers for high speed, moderate speed and slow speed passenger and freight elevators, together with descriptions of sidewalk lift controllers, reversible and non-reversible controllers for belt driven freight elevators and mechanically operated controllers for use where current conditions are extremely variable. Illustrations and descriptions are also given of such necessary elevator accessories as brake magnets, car switches, limit switches, etc. The second section of the booklet is devoted to similar controllers for use on alternating current circuits and the concluding pages contain tables of useful information, including suggestions regarding the proper type of motor to use in each case.

APPROVED ELECTRICAL DEVICES

RECEPTACLES, STANDARD.

"Bryant." Key and Pull (50 C. P. 250 V.) and Keyless (3 A. 250 V.) Wall Sockets, Brass Shell (slotted or closed bases). Key, Cat. Nos. 9184, 60018, "New Wrinkle" 66609, 68136, 68139, Angle Base 50753, and "New Wrinkle" 68224. Keyless, Cat. Nos. 9185, 50717, 60019, 60020, "New Wrinkle" 66610, 68137, 68140, Angle Base 50755 and "New Wrinkle" 68225. Pull, "New Wrinkle" Cat. Nos. 66611, 68128, 68138 and Angle Base 68236. Also all of the above types with shadeholders attached; key types with composition or insulated metal key. Brass sub-bases, Cat. Nos. 374 and 377, for use with Cat. Nos. 68139 and 68140. Approved Feb. 6. 1910. Manufactured by

The Bryant Electric Company, Bridgeport, Conn.

"Bryant 3 A. 250 V." Sign, Cat. Nos. 1700, 40488, 46749, 59108. Cleat, Cat. Nos. 9402, 4903, 921, 1011, 1123, 50715, 11221, 28795, 58949 (formerly 23209), 58300, and 58301 (formerly 23-210). Concealed, Cat. Nos. 50744; also 9447, fusible, 2 A., 125 V. Moulding Cat. Nos. 42453, 58302 and 58950 (formerly 34152). Conduit Box, Cat. Nos. 9514, 9397, 40507, 40537, 59107, 62357, 62355 and 62356. Approved Feb. 4, 1910. Manufactured by

The Bryant Electric Company, Bridgeport, Conn.

Rosette Receptacles mounted on link fuse rosette bases, 2 A., 125 V. Brass Shell. Cleat Type, Cat. Nos. 50730, 50733, "New Wrinkle" 68227, 68232, 68238. Concealed Type, Cat. Nos. 50729, 50732, "New Wrinkle" 68226, 68231, 68237. Porcelain: Cleat Type, Cat. Nos. 9434, 9436, 9438. Concealed Type, 9404, 9405, 9406. Also all of the above aypes with shadeholders attached; key types with composition or insulated metal keys. Approved Feb. 5, 1910. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

"Perkins' Key and Keyless, (2 A., 125 V.) Rosette Receptacles, mounted on link fuse rosette bases. Brass Shell. Cleat, Cat. Nos. 24991, 24994, "New Wrinkle" 68227-P and 68232-P. Concealed, Cat. Nos. 24990, 24993, "New Wrinkle" 68226-P and 68231-P. Porcelain. Cleat, Cat. Nos. 25091, 25092. Concealed, Cat. Nos. 25093, 25094. Also all of the above types with shadeholders attached; key types with composition or insulated metal keys. Approved Feb. 3, 1910. Manufactured by

The Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

"Perkins," Key (50 C. P., 250 V.) and Keyless (3 A., 250 V.) Wall Sockets, brass shell. Slotted or closed bases. Key, Cat. Nos. 9184-P "New Wrinkle" 66609-P, 68136-P, 68139-P, and angle base 68224-P. Keyless, Cat. Nos. 9185-P, "New Wrinkle" 66610-P, 68137-P, 68140-P and angle base 68225-P. Also all of the above types with shadeholders attached; key types with composition or insulated metal keys. Brass sub-bases, Cat. Nos. 374 and 377 for use with Cat. Nos. 68139-P and 68140-P. Approved Feb. 6, 1910. Manufactured by

The Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

Wall Sockets, Brass Shell. Key Cat. Nos. 2100 and angle base 2700. Keyless Cat. Nos. 2300 and angle base 2800. Cleat Type Cat. No. 3100. Approved Jan. 29, 1910. Manufactured by

Wirt Mfg. Co., Burrage, Mass.

SOCKETS, STANDARD.

Porcelain Shell Sockett, Cat. No. 61417 (417). Approved for temporary outdoor use and only when connected to stranded rubber covered wires; Jan. 28, 1910. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

Wall Sockets. Brass Shell. Key, Cat. Nos. 60430, 61066, 61067, 61069, 61387 (387), 61455 (455), 62350 and 103075. Keyless, Cat. Nos. 60387 (0387), 60431, 61456 (456) and 62351. Porcelain Shell. Key, Cat. Nos. 61087 (1087), 61237 (237) 62247 (247) and 62371 (2371). Keyless, Cat. Nos. 60237 (0237), 60247 (0247), 60371 (02371), and 61107 (107). Approved Jan. 13, 1910. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

CONDUIT BOXES.

Pressed Steel Boxes, Cat. Nos. A. 1-½, B ½, ¾, 1-½ and 2-½; C ¾ and 1-½; D 1-½ and 2-½; E 1-⅞ with suitable covers of pressed steel. Approved Jan. 28, 1910. Manufactured by

Steel City Electric Co., No. 1207 Washington ave., Pittsburg, Pa.

CONDUIT BOXES, FLOOR OUTLET.

"T. & B." Cast Iron Floor Outlet Boxes, with Hubbell receptacle 10 A., 250 V., Cat. No. 100 and "Watertight" No. 1100. Approved Jan 24, 1910. Manufactured by

Thomas & Betts Co., No. 299 Broadway, New York, N. Y.

LAMP ADJUSTERS.

This adjuster consists of a metal telescoping arm with a head for securing the device to a ceiling. Mounted in the head is a spring actuated drum on which is wound a cord. This cord is attached to the flexible conductor supplying the lamp. The device should be so installed that the arm will be used in a nearly vertical position. Vertical adjustment of lamp to be then secured by action of the drum. Approved for use only with approved reinforced portable cord; Jan. 28. 1910. Manufactured by

Frantz Specialty Mfg. Co., Sterling, Ill.

ROSETTES, FUSELESS.

"Circle T," 3 A., 250 V. Cleat, Cat. Nos. 750 and 752. Concealed Cat. No. 753. Moulding, Cat. No. 754. Approved Jan. 31, 1910 Manufactured by

Trumbull Electric Mfg Co., Plainville, Conn.

SWITCHES, OIL BREAK.

Non-automatic Oil Switches for A. C. circuits, 3300 and 6600 volts. Type D, 100-1000 amperes not over 3300 volts, 100, 200 and 300 amperes not over 6600 volts. Type I, 50 amperes, 3300 and 6600 volts. Approved Jan. 28, 1910. Manufactured by

Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

RECEPTACLES, FOR ATTACHMENT PLUGS.

"Bryant" Flush Receptacle, Edison type. Cat. No. 1708, 3 A. 250 V., 6 A. 125 V., for use with Edison type attachment plug. Approved Jan. 11, 1910. Manufactured by

The Bryant Electric Co., Bridgeport, Mass.

RECEPTACLES, MINIATURE.

"P. & S." ½ A., 125 V. Candelabra Sign Receptacles, Cat. Nos. 677, 778 and 878. Approved Jan. 13, 1910. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

SOCKETS, WEATHERPROOF.

"Freeman," 3 A., 250 V. Two-piece porcelain sockets enclosed in two-piece aluminum or brass shells. Cat. Nos. 182-185 incl. For use with 110 or 220 V. lamps in series on 600 V. circuits. Approved Feb. 2, 1910. Manufactured by

E. H. Freeman Electric Co., Trenton, N. J.

CIRCUIT BREAKERS.

"S. E." Single pole air brake types, 15-1200 Amps., not over 600 volts. Approved Jan. 29, 1910. Manufactured by

Roller-Smith Company, 203 Broadway, New York, N. Y.

NEWS NOTES

FINANCIAL.

SEATTLE, WASH.—The bids of R. H. Rollins & Sons and A. B. Leach & Company for park bonds in sum of $500,000 and the light bonds for sum of $200,000 have been accepted by the Council.

SAN FRANCISCO, CAL.—The Northern California Power Company has increased the monthly dividend from 10c to 20c per share. Books were closed February 16th and the dividend, which was payable on the 22d, was paid on the 21st, owing to the holiday.

LOS ANGELES, CAL.—At the annual meeting of the stockholders of the Pacific Lighting Corporation the officers were re-elected, as follows: C. O. G. Miller, president; George H. Collins, vice-president; Horace H. Miller, secretary. The annual reports show gross sales, $2,892,000, an increase of $346,000 over the year 1908, or 13.6 per cent. After deducting operating expenses, interest, taxes and depreciation there remained a net profit of $642,232.35, out of which was paid the regular 5 per cent dividend on the preferred stock amounting to $208,100, and a quarterly dividend on the common stock of 75c per share was paid in November amounting to $36,000, the total dividends being $244,100. The company reported no interest-bearing floating debt. The Pacific Lighting Corporation was organized May 20, 1907, succeeding the Pacific Lighting Company. It owns all the stock of the Los Angeles Gas and Electric Company and practically all of that of the Pasadena Consolidated Gas Company, as well as $220,000 bonds of the Eureka Lighting Company and other assets.

INCORPORATIONS.

BOISE, IDAHO.—The Orchard Water Company of Boise, with a capital stock of $20,000, has been incorporated by J. H. Richards, T. S. Risser and E. L. Hice.

YAMHILL, ORE.—Yamhill Mutual Telephone Company, with a capital stock of $2,500, has been incorporated by W. G. Moore, E. B. Flett and A. C. Goodrich.

SPOKANE, WASH.—The Spokane American Oil and Gas Company, with a capital stock of $1,000,000, has been incorporated by J. F. Ferguson, D. P. Reid, J. M. Ralph and P. Anderson.

PORTLAND, ORE.—Sterling Oil and Gas Company; principal office, Portland, Ore., with a capital stock of $75,000, has been incorporated by W. H. Moorehouse, W. W. Zellers and Russell E. Soewall.

VISALIA, CAL.—The Lindsay Water Company, with a capital stock of $75,000, has been incorporated by C. O. Cowles, W. C. Stelling, G. K. Hostetter, G. F. and F. F. Hostetter and Carrie L. Flagg.

TRANSMISSION.

VANCOUVER, B. C.—The Vancouver Power Company is preparing to install a 20,000 horsepower unit at the Lake Buntzen plant that will cost $500,000.

LYONSVILLE, CAL.—The Butte and Tehama Power Company has started work on its proposed power plant on Mill Creek, 14 miles south of Lyonsville.

SEATTLE, WASH.—Plans for the expenditure of over $2,500,000 in the construction of a hydroelectric power plant at Lake Tapps, Pierce County, and the development and distribution among the Sound cities of 25,000 electric horsepower, all within the next two years, have been approved by Stone & Webster of Boston, backers of the Pacific Coast Power Company and managers of the Seattle Electric Company. News was given out by Henry G. Bradlee, member of Stone & Webster.

PORT ANGELES, WASH.—The city has granted the Port Angeles Power Electric Company a franchise for the distribution, sale, etc., of electrical power. The company proposes to begin the construction of a 500 horsepower plant on Little River.

ROCKPORT, WASH.—The Skagit County Power Company is planning to begin actual construction work this spring on its power plant on the upper Skagit River, 30 miles from Rockport. The proposed power plant will cost in the neighborhood of $6,000,000. It will have a capacity of 100,000 horsepower. A flume 20,000 feet long and averaging about 20 feet in width is being built in order to obtain "head." The river at present is a succession of small cascades and will be harnessed and forced through a long tunnel, most of which is to be cut through solid rock. E. H. Freeman, Anacortes, Wash., is field manager. In connection with the work the Great Northern Railway, A. Stewart, assistant chief engineer, Seattle, Wash., is to build a 30-mile branch to the site of the power plant, to be used in carrying in supplies for the work. Surveys for the branch have been made and work is to be started shortly.

WASHINGTON, D. C.—A request has been received from the Edison Electric Company for four years' more time to carry out the conditions of its permits for further development on Kern River. It was originally allowed five years to do a certain amount of construction. Kern River being in Representative Smith's district, he was asked to introduce a bill giving the additional time. The request met with refusal on the ground that the company must live up to its agreements with the Government as others are required to do, and also because an expenditure of only $160,000 in four years on projects totaling eight or nine millions did not make it appear prima facie that the company had put forth much effort to carry out the conditions agreed to. If the company produces evidence of good faith the Forest Service will probably help it out, but Smith's stand prevents the establishment of legislative precedent.

ILLUMINATION.

EVERETT, WASH.—The Everett Gas Company will extend its mains in different sections of the city.

OLYMPIA, WASH.—Henry H. Hyde of Tacoma has purchased the Olympia Gas Company and announces that extensions and improvements will be made at once.

MEDFORD, ORE.—J. R. Anderson of Pasadena, who is connected with the company owning gas plants in California, is in Medford looking over the field and may request a franchise.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company will commence in a few days laying gas mains to Ingomar tract which is located on Prospect avenue, west of the Hollywood hotel.

MEDFORD, ORE.—Elmer C. Johnson, of Portland, has asked a franchise for a gas plant in Medford, for a period of 40 years. If the franchise is granted Mr. Johnson will expend $12,500 within 12 months for material.

CENTRALIA, WASH.—N. W. Mills of Tacoma has secured the contract to build a concrete gas tank for the Centralia and Chehalis Gas Company, estimated cost will be between $12,000 and $15,000, work to be commenced at once and completed May 1st. It will be located on Coal creek near Chehalis.

CITY OF MEXICO, MEX.—The estimate of loss by a fire in the shops of the Mexican Central division of the National Railways of Mexico in this city recently is from $25,000 to $30,000. Officials of that company state that the gas plant was only partly destroyed and will within a few days, be in operation to about one-half its regular capacity.

GRANGEVILLE, IDAHO.—W. A. Clark of Moscow, who conducts the gas plant in this city, has asked for a twenty-five year franchise in Grangeville for the purpose of laying gas mains in the streets and also to convey gas to various sections of the city for the purpose of lighting and heating, and it is said the Council looks with considerable favor upon the granting of such a franchise.

TRANSPORTATION.

VACAVILLE, CAL.—The Vallejo and Northern Railroad Company has applied for a 50-year franchise through this city.

BIGFORK, MONT.—Civil Engineer P. E. March has begun the survey for the proposed electric line to be built by the Whitefish & Polson Electric Railway Company.

SAN JOSE, CAL.—F. E. Chapin, vice-president and general manager of the Peninsula Railway Company, announces that the line between Palo Alto and San Jose has been completed and electrized and that it will be ready for operation about March 1st.

SAN FRANCISCO, CAL.—At the annual meeting of the stockholders of the Petaluma and Santa Rosa Railroad Company the board of directors was re-elected, to wit: E. M. Van Frank, president; Thomas Archer, secretary; A. W. Ballard, John A. McNear, Francis Cutting, Frank A. Brush and Rudolph Spreckels. Edwin T. McMurray is the attorney. The report made by the president showed about $15,000 increase in receipts over and above operating expenses as compared with the previous year. No dividends have yet been paid, but this electric line is handling a large passenger and freight traffic. At the directors' meeting two propositions were discussed, one being the extension of the line from Graton to Camp Meeker, and the Russian River; the other an extension to Occidental.

FRESNO, CAL.—Work on the long fill between Fowler and Selma on the right of way of the Fresno-Hanford interurban railroad, which has been in progress for the past two weeks, is finished, George W. Elder has announced. With the completion of this work the grading camp will be moved to a point just this side of Selma, where another fill will be made. In filling up the first arroyo, 12,000 yards of earth were required. The work is practically completed, however, and the fill is up to the grade. A representative of the General Electric Company of Schenectady, N. Y., is in Fresno conferring with Granger and George A. Yuille regarding supplies for the new power plant at Fowler and the car motors. The General Electric Company agrees to have everything on the ground in this city within four months. The Hudson Counties Improvement Company will close the contract.

SACRAMENTO, CAL.—A. D. Miller, manager of the Nevada Transit Company of Reno, who has been employed by that company since it became the property of the Hammon interests, will become manager of the Central California Tractfon Company, with headquarters at Stockton. The Central California Traction Company has a line operating between Lodi and Stockton and is building another between Sacramento and Stockton. It is planned by the company to have the Sacramento-Stockton line in operation by the first or middle of July. At present no work is being done on the Sacramento end of the line, an injunction suit preventing work near the State Agricultural Park and work on Eighth street, this city, being suspended pending the adjustment of an agreement pertaining to paying the property owners for a portion of the street.

WATERWORKS.

EL CENTRO, CAL.—$69,000 bonds will be issued for the acquirement of a municipal water system for El Centro.

PATTERSON, EMERALD STATION, CAL.—An entire waterworks system is to be installed here by the J. A. Ulmer Machinery Company.

CRESSWELL, ORE.—The City Council granted to R. H. Parsons of this city, a franchise to furnish the city with water for a period of 25 years.

TAFT, CAL.—Harry D. Chapman, a contracting engineer of Ocean Park, has asked for a franchise for the installation of a water system in the town of Taft.

HOLTVILLE, CAL.—The City Council passed an ordinance in regard to the issuance and sale of bonds to the amount of $37,000 for the acquisition, construction and completion of a waterworks.

PORTLAND, ORE.—Sealed proposals have been received by Auditor A. L. Barbour for the construction of a water main in Division street from the west line of East Tenth street, to a six-inch main in East Eleventh street.

CORONA, CAL.—Seven or eight miles of roads are being graded and three miles of pipe are being laid, four or five additional wells are to be put down and a 150 horsepower pump plant will be installed by the Citrus Belt Lane Co.

TACOMA, WASH.—The City Council has passed an ordinance providing for the construction of water mains on South Seventh street from Lawrence street to Proctor street; on South Eighth street, from Lawrence street to Proctor street and on South Ninth street, Tenth and Eleventh street, each from Lawrence to Proctor streets.

ESCONDIDO, CAL.—Officials of East San Pasqual Water Company and West San Pasqual Water Company, are perfecting plans for the merging of the two companies. The new company will extend a system two miles up the San Pasqual river valley. Here tanks will be erected and arrangements made to store water to provide irrigation during the dry season.

SUSANVILLE, CAL.—Notices of the appropriation of the waters of Eagle Lake and Willow Creek have been filed with County Recorder Sharp. The appropriations call for 200,000 inches of the waters of Eagle Lake and the streams flowing into the lake, the 200,000 inches of the waters of Willow creek. The locations are made by Alva Udell, an attorney of San Francisco. The waters of Eagle Lake are claimed by a prior location made by the Lassen-Willow Creek Water Company, formed about four years ago for the purpose of tapping the lake by a tunnel over a mile in length.

SACRAMENTO, CAL.—The East Sacramento Water Company has applied to the County Board of Supervisors for permission to lay pipes, etc., in East Sacramento, Elmhurst, Brighton and all other principal suburbs. The site for the tower and works was decided upon. The plant will be housed in a structure of reinforced concrete, with steel floors and bracings. The tower will have a capacity of 150,000 gallons and the floor of the tank will be 100 feet above ground, thus insuring a good force. About 800,000 feet of pipe will be laid and will extend to Elmhurst, the district about Florin, to East Sacramento, and eventually to Brighton and other outlying communities.